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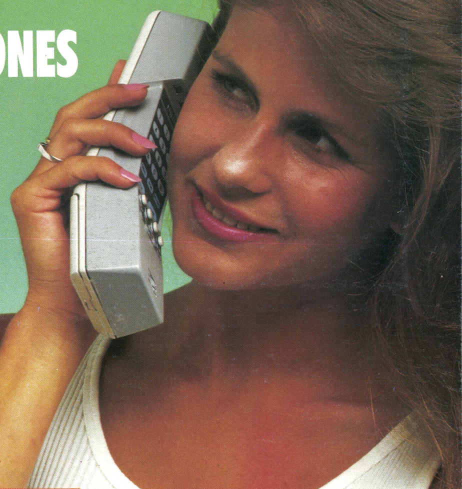

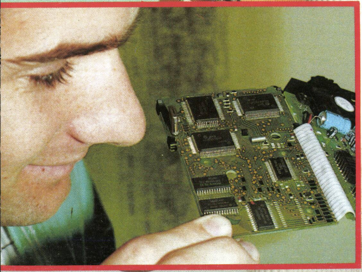

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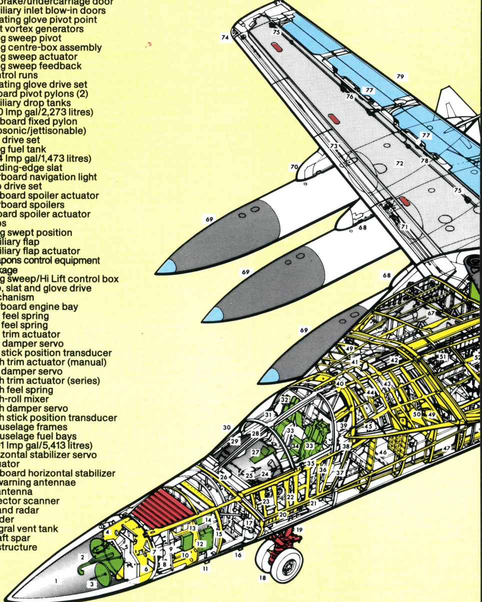
F-111 cutaway

1 Hinged nose cone
2 Attack radar
3 Terrain-following radar
4 Nose hinges (2)
5 Radar mounting
6 Nose lock
7 Angle-of-sideslip probe
8 Homing antenna (high)
9 Forward warning antenna
10 Homing antenna (low and mid)
11 ALR-41 antenna
12 Flight control computers
13 Feel and trim assembly
14 Forward avionics bay
15 Angle-of-attack probe
16 UHF Comm/Tacan No 2
17 Module forward bulkhead and stabilization flaps (2)
18 Twin nosewheels
19 Shock strut
20 Underfloor impact attenuation bag stowage (4)
21 Nosewheel well
22 LOX converter
23 Rudder pedals
24 Control column
25 LOX heat exchanger
26 Auxiliary flotation bag pressure bottle
27 Weapons sight
28 Forward parachute bridle line
29 De-fog nozzle
30 Windscreen
31 Starboard console
32 Emergency oxygen bottle
33 Crew seats
34 Bulkhead console
35 Wing sweep control handle
36 Recovery chute catapult
37 Provision/survival pack
38 Attenuation bags pressure bottle
39 Recovery chute
40 Aft parachute bridle line
41 UHF
42 Stabilization-brake chute
43 Self-righting bag
44 UHF
45 ECM antennae (port and starboard)
46 Forward fuselage fuel bay (2,340 Imp gal/10,638 litres)
47 Ground refuelling receptacle
48 Weapons bay
49 Module pitch flaps (port and starboard)
50 Aft flotation bag stowage
51 Air refuelling receptacle
52 Primary heat-exchanger (air-to-water)
53 Ram air inlet
54 Rate gyros
55 Rotating glove
56 Inlet variable spike
57 Port intake
58 Air brake/undercarriage door
59 Auxiliary inlet blow-in doors
60 Rotating glove pivot point
61 Inlet vortex generators
62 Wing sweep pivot
63 Wing centre-box assembly
64 Wing sweep actuator
65 Wing sweep feedback
66 Control runs
67 Rotating glove drive set
68 Inboard pivot pylons (2)
69 Auxiliary drop tanks (500 Imp gal/2,273 litres)
70 Outboard fixed pylon (subsonic/jettisonable)
71 Slat drive set
72 Wing fuel tank (324 Imp gal/1,473 litres)
73 Leading-edge slat
74 Starboard navigation light
75 Flap drive set
76 Outboard spoiler actuator
77 Starboard spoilers
78 Inboard spoiler actuator
79 Flaps
80 Wing swept position
81 Auxiliary flap
82 Auxiliary flap actuator
83 Weapons control equipment package
84 Wing sweep/Hi Lift control box
85 Flap, slat and glove drive mechanism
86 Starboard engine bay
87 Yaw feel spring
88 Roll feel spring
89 Yaw trim actuator
90 Yaw damper servo
91 Roll stick position transducer
92 Pitch trim actuator (manual)
93 Roll damper servo
94 Pitch trim actuator (series)
95 Pitch feel spring
96 Pitch-roll mixer
97 Pitch damper servo
98 Pitch stick position transducer
99 Aft fuselage frames
100 Aft fuselage fuel bays (1,191 Imp gal/5,413 litres)
101 Horizontal stabilizer servo actuator
102 Starboard horizontal stabilizer
103 Aft warning antennae
104 HF antenna
105 Detector scanner
106 X-Band radar
107 Rudder
108 Integral vent tank
109 Fin aft spar
110 Fin structure



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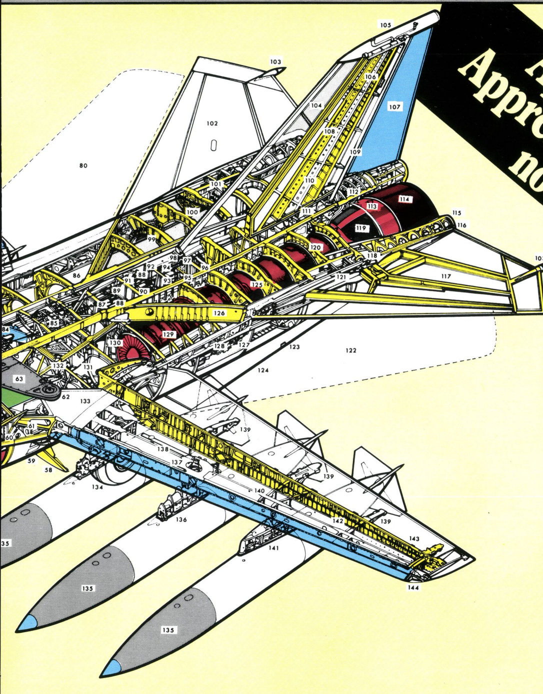

111 Fin/fuselage attachment
112 Rudder servo actuator
113 Variable nozzle
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115 ECM antenna
116 ALR-41 antenna
117 Horizontal stabilizer structure
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129 Pratt & Whitney TF30 turbofan
130 Three-stage fan
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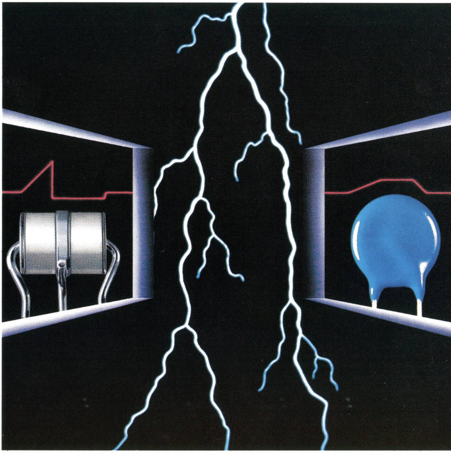

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Low cost stereo amp

It's taking a little longer than we had hoped, but our new 30W per channel stereo amplifier design should at last be ready for publication next month. Offering excellent performance, combined with easy construction and a low price, you'll find it's been worth the wait.

**Note: although these articles have been prepared for publication, circumstances may change the final content of the issue.*

(Advertisement)

KIT COMPUTER REVIEW

By Jim Rowe

Reprinted in part from the December 1987 issue of Electronics Australia', by arrangement.

A couple of weeks ago I discovered that Dick Smith Electronics was about to release a new AT clone in low-cost kit form. So when the opportunity came to assemble an advance sample kit for this review. I jumped at the chance.

Particularly when I learned that the kit was essentially a 'knocked down" machine, which didn't involved any soldering or the tedious low-level assembly - just bolting pre-assembled (and tested) modules together and plugging in cables to connect them all up.

By the way, the modules making up the kits are all going to be available separately, so you don't have to buy them all at once. This also means that you could buy them separately.

The kit itself goes together to make a standard 8-slot AT level machine, with space on the motherboard for up to 1 megabyte of RAM and able to run at any of four clock speeds: 6MHz, 8MHz, 10MHz or 12MHz. It features a 200W switch-mode power supply and a choice of video, I/O, disk controllers and drives, all housed in a standard two tone bone coloured box. There's also a choice of either 84-key or 101 key keyboards.

In theory then it all sounds great. But how did it turn out in practice?

Everything seemed to be attractively packaged, and protected against damage.

There is literally no soldering to do in assembling the kit, because all cabling is supplied ready assembled. All you need to do is identify where they go, and connect them up.

Needless to say, there are various links and DIP switches to check on the various boards, before you mount them and connect things up.

You have a choice of video/ graphics adaptor card as there are three available. These are a mono adaptor (MDA) with parallel printer port; a colour adaptor (CGA), also with printer port; or an extended colour graphics adaptor (RGA), with the usual multiple modes including Hercules.

All in all, the whole job took about 3 hours to assemble.

When it was complete, I hooked it up to the monitor and turned on the power. Everything sprang to life very smoothly.

How does it perform? Not too badly at all. I sooled Peter Norton's Advanced "System Information" utility onto it, and it came up the following CI (computing index) figures for the kit's CPU performance compared with an original IBM PC/XT:

CLOCK SPEED	CI RATING
6MHz	5.1
8MHz	7.7
10MHz	9.2
12MHz	11.7

I for one certainly enjoyed putting the sample kit together. All I have to do now is work out how I can afford to buy one — preferably the one I've already put together!

Needless to say, you'll find the A computer kits at all Dick Smith Electronics stores, and at many of its larger dealers.

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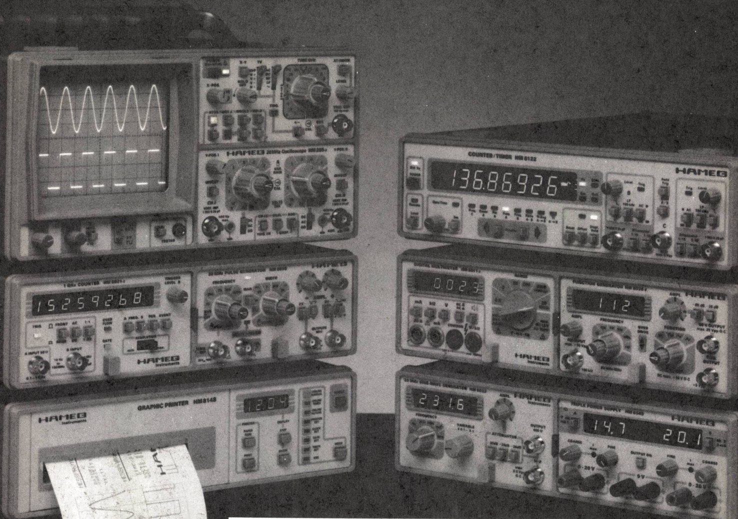

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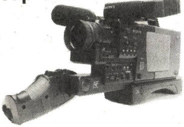
Electronics Australia

Volume 50, No.7

July 1988

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

Sony's new V200E camcorder supreme



At last, a Video-8 camcorder which records and plays back PCM digital stereo sound. Our exclusive review of Sony's impressive new top-of-the-line V200E starts on page 12.

Projects to build

This month our construction projects include an easy to build and use tuner for musical instruments, a protector for hifi speakers, a low cost line filter to suppress spikes and RFI, and The Slosher – a gadget to make etching PC boards a lot easier.

Surface Mount feature

This month's special feature on surface mount technology looks at how many more Australian firms are getting into SMT, thanks to the development of smaller-scale and more reasonably priced production equipment. (See page 104)

ON THE COVER

Our picture of the lovely lady using a cordless phone was provided by Dick Smith Electronics, and needless to say DSE sells the phone she's using. The picture of a PCB using surface mount technology came from its designers, RCS Design of Alphington, Vic.

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Letters to the

Frankly incredible!

I have been a reader of EA for quite a number of years and am pleased with its standard. However, I'd like to raise an objection to some of the comments made in the "Frankly Frank" article (EA April 88).

In moving from the topic of electrons to things of more cosmic proportion, Mr Linton-Simpkins mentions the calculation made by an American bishop last century of the actual date of creation. He seems to expect us to choose between the bishop's absurdly accurate "calculation" and the idea that we evolved from hydrogen atoms through purely natural processes. I find neither idea credible.

There are many scientists these days who have rejected evolution on scientific grounds. Also I think you would find very few Christians who believe that the Bible can be used to calculate an exact date for creation. It is grossly unfair to the Creation Science movement to suggest that all its adherents believe that the universe was created at 0900 on Thursday, 5555 years ago (or whatever the date is).

Incidentally, speaking of electrons, the inventor of the thermionic valve (Sir Ambrose Fleming, M.A., D.Sc., F.R.S.) founded the Evolution Protest Movement – an organisation which has produced a great amount of literature against evolution.

Matthew Murphy,
West Ryde, NSW.

Ultimate cable – 1

The recently published article on how to obtain the perfect speaker cable using mercury encapsulated in tubing was, joke or not, a very irresponsible act.

Although a warning was given in relation to the dangers of mercury poisoning, it was not stated that mercury rates among the most deadliest substances on earth.

Mercury KILLS, as certain and as silent as a cobra. The consequences of a spill on the carpet or even the workshop floor are impossible to control, by anyone not trained in the use of this substance.

Further to suggest the use of funnels, garden hose and metallic hoseclips, not to mention the application of heat to seal over the tubing end is the most idiotic I have ever read.

I sincerely hope it was intended as a joke or black comedy, if not you were scraping the bottom of the barrel and will publish almost anything providing it fills the gaps.

I am looking forward to reading how to make an atomic bomb.

M. de Bortella,
Derby, WA.

Comment: Sorry we upset you with our little joke. Many others thought it was very funny...

Ultimate cable – 2

Your timely article (April 1st, 1988) by G. Leadbeater on Mercury-filled cables has ensured my continuing to buy your magazine, providing you occasionally have articles in a similar vein. Endless series of uncritical articles with the reporter's "golly, wizz, wow" reaction pales a bit.

Also several of your ads should be forced to have a "health (wealth) hazard" warning stamped on them. "Digital Audio Leads" indeed! Shouldn't they be twisted terminated pairs, or ribbon cables for that "real digital feel" and to ensure that the (audio analogue) digital signals know they are in a truly caring digital home?

Leonard Spyker,
Karrinyup, WA

P.S. On second thoughts I could make some money out of that idea, if I could only find an unscrupulous manufacturer!

Call for help

I am wondering if any reader(s) may know where I could obtain a replacement speaker transformer (output) for a "Jansen 100 Bass" valve amplifier? I would also appreciate any advice on suitable substitutes etc.

M.J. Fry
12 Stuart Street,
North Mackay, Qld 4740

Low distortion oscillator

I feel I may be able to shed some light on the problems experienced with the "Ultra Low Distortion Oscillator" by correspondents in the September and November 1987 issues. Both these peo-

editor

ple found it imposible to obtain operation of the frequency control potentiometer in accordance with the printed scales supplied in their Altronics kits. I am certain the cause is very simple and relates to the ambiguous labelling of potentiometers supplied by various stores in the last several years.

There are two distinct and CONFLICTING systems of coding potentiometers as to their taper. Many store staff, as well as customers, are unaware of this and regularly supply the wrong types. I feel this has occurred with the Altronics kits purchased by your two correspondents.

Many years ago there was only one standard usually found in Australia. Let me call this the OLD system. More recently potentiometers started appearing at your "Friendly Parts Grocers" with a new set of codes. This caused much confusion at the time and one store (DSE) even went as far as to place signs over the potentiometer bins explaining the new codes. I understand these codes are a metric standard and so are used in Asia as well as Europe.

The codes, based on my experience, are as follows:

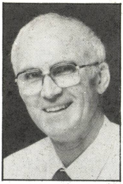
OLD system:
  A = linear
  C = logarithmic
Metric system:
  A = semi-log (also known as audio taper)
  B = linear
  C = anti-log
  D = logarithmic

With the codes A and C having very different meanings in the two systems it is obvious that Murphy's Law will apply. If your two correspondents check their pots with an ohm meter they will probably quickly find they are not linear but most likely semi-log types confusingly labelled with the letter A.

Note carefully, a potentiometer does NOT have to be metric size (6mm shaft etc) to be labelled with metric codes, however ones stamped "AUST" use the OLD system.

When in doubt reach for the multimeter, set the potentiometer to the centre of its travel and measure the two halves. A linear will have equal halves and the others unequal – logarithmic

continued on page 140



Editorial Viewpoint

Calling all hobbyists – here's your big chance!

Over the years, I've noticed an interesting relationship between the hobby side of electronics and the industry in general. When there's a high level of hobby interest and activity, the industry as a whole seems to do well. On the other hand when hobby activity seems to wane and enthusiasm fades, the whole industry slows down and goes through more difficult times.

Why should this be? I believe it's because unlike so many other fields of endeavour, electronics tends to be much more than just a job. A very high proportion of the people who work in the industry as engineers, technicians and managers started off as hobbyists, and a great many still are. In many ways hobby electronics is the breeding ground for new engineers and technicians, so when the hobby area is thriving, this automatically injects more energy and enthusiasm into the industry as a whole.

One very good way to help build a stronger industry, then, is to encourage more hobby activity – and that's exactly what *EA* has decided to do, with the generous help and support of major retailer Dick Smith Electronics. In this month's issue we're launching the **Grand Aussie Hobby Electronics Contest**, offering some great prizes worth over $3500 for the best hobby projects from both beginners and more experienced hobbyists. You can read all about it on pages 102-103.

We're not looking for highly exotic, super complicated and expensive projects that only three people with engineering degrees and a large bank account will be able to build. Quite the opposite; we'll be looking for elegant, simple projects that cost less than $100 and will appeal to as many people as possible. So new enthusiasts really *will* have just as much chance of winning as the old timers and professionals.

The deadline for entries is September 30, so now's the time to start working on that prize winning project idea!

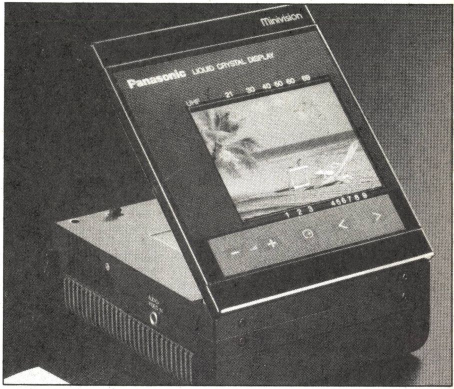
By the way, you've no doubt discovered that our cover price has risen with this issue. We're sorry about that, but we simply couldn't avoid the rise any longer. It's been 16 months since the last rise, and paper costs alone have risen by well over 10% in that time – apart from all the other costs involved in producing a magazine like *EA*.

On the bright side, management *has* allowed me to hold the current "Special Editor's Offer" subscription prices down for another month or two. So right now, as you'll see from my ad at the back, it's an even better deal than it was before the rise...

Jim Rowe

What's New In Entertainment Electronics

New 3" colour portable from Panasonic



Panasonic is about to release a new and highly portable Minivision colour TV receiver, with 75mm LCD screen.

The new LCD screen used in the set uses a thin-film transistor (TFT) active matrix scanning system, claimed to produce exceptionally bright images with excellent colour contrast. It provides a total of 102,672 pixels resolution (276 x 372), with a black matrix system for enhanced overall contrast and detail.

The Minivision's display panel swings upward for convenient viewing, and also to make use of external sunlight or artificial lighting. Alternatively the panel may be left down, which makes use of an internal source of illumination. Viewing angle of the LCD display is claimed to be 80° in the horizontal plane and 60° vertically.

The receiver section of the Minivision features automatic fine tuning and also auto-search tuning, to seek out the strongest available signals. Both VHF and UHF bands are covered.

Also provided is a direct video input, to allow the Minivision to be used as a colour monitor for video cameras and camcorders.

The Minivision will run from alkaline batteries and gives 10 hours of operation when external illumination is used. It can also be powered from the mains via an adaptor, from rechargeable NiCad batteries, or from a vehicle cigarette lighter outlet. Power consumption is 3.5W with backlight on, or 10W via the AC adaptor.

New Pioneer car speakers

Pioneer Electronics Australia has released six new models on to the market to complement its existing car speaker range.

The new speakers offer high power handling, accurate reproduction, HR water resistant cones and a high level of aesthetic appeal.

The TS 1604 is a 16cm flush mount 2-way speaker with 100 watt power handling. The TS1605, a 16cm flush mount 3-way speaker, is a direct replacement for a current Pioneer model – bringing a boost in power handling from 60 to 80 watts.

The TS1606 is a 2-way speaker boasting 150 watt power handling and has been brought into the range as an ideal match for the existing TS 1609 model. The TS 1607 is a 3-way speaker which boosts the power handling capabilities of its predecessor from 100 watt to 120 watt.

Pioneer's latest surface mount speaker is the TS-X25, a 3-way speaker system with 80 watt power handling. Features include a horn tweeter and square woofer and bass reflex enclosure, to produce an improved bass response.

Finally, the new TS1700 is a 2-way, cross axial speaker – ensuring more directional reproduction of highs. This speaker effortlessly handles power of up to 150 watts.

Aussie loop antennas attract OS orders

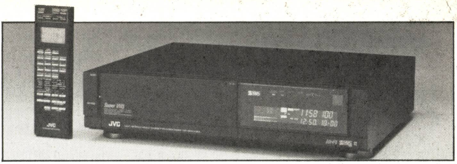
The Techniloop range of portable loop antennas for improving radio reception over the frequency range from 200kHz to 28MHz is proving popular overseas, as well as within Australia.

Favourable reviews by Radio Australia and HCJB Ecuador, as well as a "best performance" test report in the *World Radio TV Handbook* have resulted in good overseas orders, says David Whitby the manager of Technikit Electronics, producers of the antennas. Three models are available, both active and passive, with prices from $70 to $200.

Applications include improved and lower noise AM reception in country areas, as well as improved shortwave reception. The antennas are being used by DX radio enthusiasts around the world.

Further information is available from Technikit Electronics, 654 Calder Highway, Keilor 3036 or phone (03) 336 7840.

First "Euro" Super-VHS video recorder from JVC



After having finalised the specifications for the European version of Super VHS earlier this year, JVC has announced its first Super VHS Euro System VCR – the HR-S5000 – available in several different versions designed to adapt to the needs of each European country.

Super VHS delivers more than 400 lines of horizontal resolution, a dramatic improvement made possible by recording the luminance signal in a higher and broader carrier frequency band. An equally significant improvement in the S/N ratio has been achieved by expanding the frequency deviation and using a non-linear sub-emphasis system. And, for the best possible colour reproduction, Super VHS incorporates a separate luminance (Y) and chrominance (C) signal processing method to reduce interference between signal components. This virtually eliminates cross-colour disturbance and moire, providing pure, realistic colour. The result is a picture of greatly enhanced clarity, detail, and presence.

To ensure that none of that Super VHS quality is lost, the HR-S5000 has a built-in wide-bandwidth tuner capable of detecting a much wider range of video signal frequencies than before. And, for the best-possible picture quality in both the SP and the LP modes, a **Super Double-Azimuth 4-Head (Super DA-4)** combination video head system has been incorporated. First-rate picture quality in normal VHS recording and playback is also ensured by HQ (High Quality) picture improvement circuits.

For the audio counterpart to its Super VHS picture, the HR-S5000 offers near-digital Hi-Fi Stereo sound. Two rotary FM-audio heads combined with an advanced L/R channel independent switching noise reduction circuit provide sound reproduction that is claimed to be greatly superior to conventional audio tapes.

The HR-S5000 can also function as an editing recorder of near-professional quality, incorporating a flying erase head for precise insert editing and the Zero Frame Editing system for assemble editing. An audio dubbing circuit is also provided.

The HR-S5000 is not expected to be available in Australia until late 1988.

New VHS-C Camcorder from JVC

The new GR-45EA VHS-C camcorder from JVC weighs only 1.2kg and has HQ (High Quality) circuitry and a new super high resolution CCD image sensor. For those people who are more creative there is a manual overide autofocus system, variable speed electronic shutter and two speed 6 x power zooming.

For added convenience the GR-45EA offers a Master Edit Control System, a second record start/stop button, selectable date/time recording and a free "Video School" Demonstration Tape exclusively made for JVC in Australia.

The GR-45 uses a new ½" CCD sensor with a resolution of 420,000 pixels. It is equipped with a selectable high-speed electronic shutter, switchable between 1/50, 1/250, 1/500, 1/1000 of a second to add greater creative possibilities in video movie-making. The higher the shutter speed, the less light enters the CCD, making pictures darker. Therefore, it should be noted that special attention to lighting conditions is needed when a high-speed shutter technique is used.

At 1/1000th of a second, fast action appears sharp and clear even when played back in still or slow motion mode. The 1/250 shutter speed keeps panning shots, shots of running childrens' face and the like, free of blur. Variable shutter speeds make possible advanced camera work like blurred backgrounds with the subject in focus.

The newly developed Master Edit Control System controls in automatic sync the VideoMovie and a connected recording deck, for accurate edits. To make use of this system, the recording deck must have a remote pause control terminal, through which it receives a trigger signal from the playback VideoMovie so that it can start recording exactly when the GR-45EA starts sending the material to be recorded.

Recommended retail price of the GR-45 is $3099.

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The **Jecklin Floats** have been designed by a Swiss recording engineer, so naturally long term continuous usage, coupled with high accuracy and high volume level performance was of uppermost importance.

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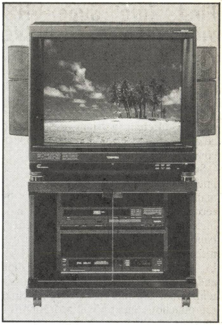
Dyn/8/2

Toshiba announces 30″ CTV with "frame double scanning"



Toshiba Corporation has released the first of a new range of high resolution enhanced-NTSC colour TV receivers, a 30″ model known as the 30ID1. At present this is only being sold in the Japanese domestic market, but it will apparently be released in the USA later in the year. No announcement has been made as yet regarding a possible PAL version.

At the heart of the new system is a technique for displaying full frames at the NTSC field scanning rate of 60Hz, rather than only fields. This is achieved by storing the broadcast alternate-field information in LSI memory chips, and combining it to give display of 60 full frames each second.

To obviate any ambiguity that this technique could produce with moving elements in the picture, Toshiba's circuitry also identifies moving picture elements, and displays these using a technique known as "line double scanning". This appears to involve scanning these sections twice from the last relevant field received, instead of combining elements from two succeeding fields.

The new TV incorporates five 1-megabit image memory chips for "frame memory" storage, five 256K-bit "line memory" chips and three custom LSI devices for logic functions. The 30ID1 has a zoom function which can enlarge 1/16 of the screen to 1/4 screen size, or 1/4 screen area to full screen. It can also divide the screen into 16 areas to display sequential still pictures or multiple TV programs.

New vintage radio society for NSW

Early wireless and sound system enthusiasts in Sydney will now be able to meet regularly to explore common interests and aims, thanks to a new society being started by collector John Murt.

Murt launched his proposed Early Wireless & Sound Society of NSW at a recent meeting of the Phonograph Society of NSW, explaining that "One of the reasons I want to create a society is that currently there is no active society in Sydney."

The main objectives of the Society will be to encourage the preservation, restoration and collecting of early radio sets. It is intended that a quarterly newsletter will be published, informing members of the history of various aspects of early radio, availability of parts, film nights, auctions and exhibitions.

John Murt says his aim is for the monthly meetings "to be both educational and entertaining – not just purely exhibiting members' prized objects, but presenting all aspects of the history and technology to do with early wireless."

An RCA Radiola type 103 speaker from 1927, in John Murt's own collection.

Membership will be open to anyone who shares these interests. Enquiries may be directed to John Murt, Early Wirless & Sound Society of NSW, PO Box 623, Lane Cove 2066 or 'phone (02) 488 8184.

Murray Amplifiers joins LSE Technology

Murray Amplifiers, the well known professional consultancy, designer and supplier of quality electro acoustic systems has joined LSE Technology, a leader in design and provision of turnkey communications and broadcasting systems. This acquisition will enable the joint group to design, install and commission complete professional sound reinforcement, broadcasting studio and public address systems, in addition to the normal systems provided by LSE.

Both companies will now be co-located at a modern facility in Frenchs Forest, Sydney to enable the maximum co-ordination of joint activities.

Murray Amplifiers' products are widely used. The Australian Broadcasting Corporation used Murray products for the television coverage of the 1982 Commonwealth Games in Brisbane; Murray supplied the audio equipment used in the new Parliament House, Papua New Guinea, as well as designing and installing the audio system for the new Parliament House in Canberra. In addition, Murray have supplied the amplification and distribution equipment used in the Sydney Opera House, and supplied sound reinforcement and recording facilities for St Andrew's Cathedral.

New TDK VHS-C tapes

Confident that the VHS-C video format will boom in Australia, TDK has announced two VHS-C video tapes. These are E-HG (Extra – High Grade) and HD-XPRO (High Definition – Excellent Grade), which are both available in 30 minutes playing time and retail for $18.95 and $29.95 respectively.

The E-HG formulation offers high picture quality and is suited for both indoor and outdoor movies. TDK claims major improvements in the tape formulation of E-HG make it ideal for recordings to be used as a permanent video collection. It is also said to deliever exceptional pictures even in LP mode.

HD-XPRO tape is claimed to offer the highest quality of any VHS-C format on the consumer market. Its development incorporated TDK's most advanced techniques and offers what is said to be the world's highest BET value of 50m2-g. (This is a unit of measurement showing the size of particles. The smaller the size the higher the BET value, the better the video tape.) It is ideally suited for such applications as original mastering and as a master tape suitable for editing.

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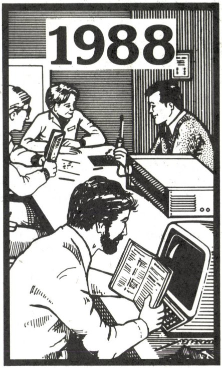

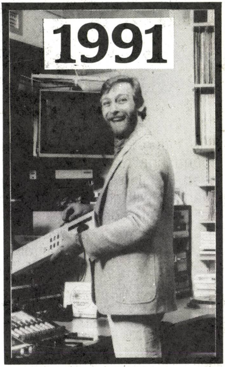

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ALA/ST6439/EA788

Exclusive video review:

Sony's V200E – camcorder supreme!

The Video-8 format has had provision for PCM digital stereo sound right from the start, but until now this facility hasn't been available on a compact camera-recorder. That's all changed with the new Sony top of the line CCD-V200E, which not only provides digital sound but almost every other feature you could want as well. Here's a sneak look at the first sample brought into Australia:

by JIM ROWE

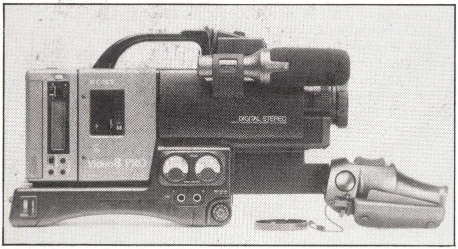
A couple of months ago, we were able to check out two of Sony's new Video-8 camcorder models – the economy limited-edition CCD-AU200, and the more advanced CCD-V50E model with built-in digital image memory. They were very impressive, and seemed to represent excellent value for money.

Following on from this, a few days ago I had a call from the Sony marketing people asking if we would like to look at an advance sample of the very latest model in the Video-8 range, just received from Japan. It was the new top of the line "PRO" model, and the first camcorder ever to provide PCM digital stereo sound *as well as* the FM sound provided on all previous and existing models, they explained. No prizes for guessing our answer!

The only catch was that we would only be able to have it for a few days, as it was the only one in the country and was going to be in big demand for demonstrations. So when it arrived the next day, we had to drop everything and check it out *fast*...

But it was definitely worth it. The CCD-V200E "PRO" really is without a doubt the *Rolls-Royce* of the Video-8 format, and might well also rank as "numero uno" of all the camcorders – regardless of format. It's that good.

In fact it seems to provide virtually all of the facilities you'd find on a professional ENG camera-recorder, as used by the TV stations. And the digital sound performance would certainly be very close to broadcast quality, with the picture quality not all that far behind. So far has Video-8 technology come, in but a few short years!



The right-hand side of the V200E provides access to the deck itself (light grey), the audio recording level controls and meters.

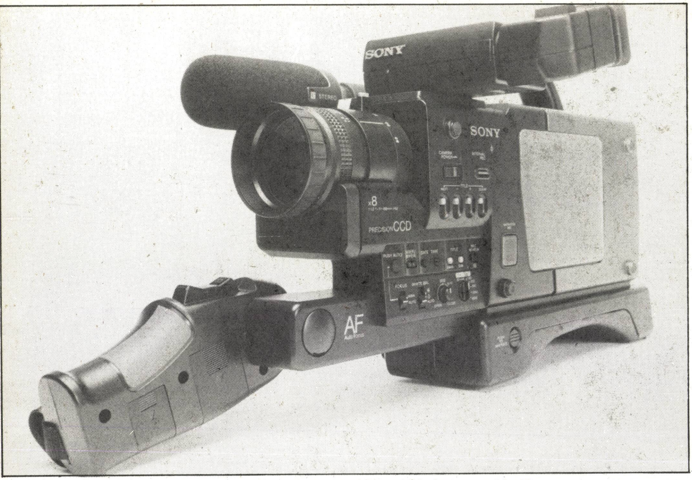
Where to begin? The V200E seems to have all of the features of its smaller brothers, and then some. The first thing we noticed is that it's somewhat longer and heavier: external measurements are 405 x 226 x 133mm, with handle and viewfinder folded, with a weight of 3.3kg including battery pack and tape cassette.

Of course unlike the smaller models it is designed to perch on your right shoulder, like a professional ENG or 16mm movie camera. And for this kind of use the V200E's size and weight are quite modest. More importantly it is very well balanced, so that when mounted on your shoulder it's very easy to manoeuvre and move about with.

Like professional cameras designed for shoulder use, it has the viewfinder mounted just forward of centre, with a telescoping mount so that you can extend it to suit either your right or left eye as desired. The viewfinder also tilts through a large arc vertically, not only to suit different sized heads but also to allow for convenient tripod use and operation near the ground.

Also like professional cameras the V200E has a solid carrying handle on the top of the case, and an operating handle at the front which can be set to a number of positions to suit the operator and situation. The operating handle gives you both main controls needed for convenient one-hand operation: *recording on/off*, operated by your thumb, and *zoom in/out* which is operated by your first and second fingers. Your left hand is free for steadying the camera or whatever. Very nice indeed!

The operating handle folds back underneath the lens for transport, or for



The V200E is Sony's new top-of-the-line model, with almost every possible feature and facility.

using the camcorder on a tripod. Similarly the viewfinder folds back over the top of the lens for transport, to give a relatively compact package.

As part of the balancing technique, the rechargeable battery pack is no longer housed in the operating handle as with the smaller models, but now fits into a compartment at the top rear of the case.

So much for the basic setup, very satisfying as it is. Now let's look at the details.

First the camera section. This is not dramatically different from that on the smaller models, although it certainly has a higher-resolution CCD image sensor like the new V90E. The sensor is capable of resolving 495,000 pixels, compared to the 291,000 available on lower cost models.

It also has a rather better lens. This gives you a power zoom ratio of 8:1, from 11 to 88mm focal length, and with a maximum aperture of F/1.2 as compared with the F/1.6 lens fitted to the smaller models. Minimum illumination is accordingly 5 lux (0.5 footcandles), somewhat better than the 12 lux figure quoted for the others.

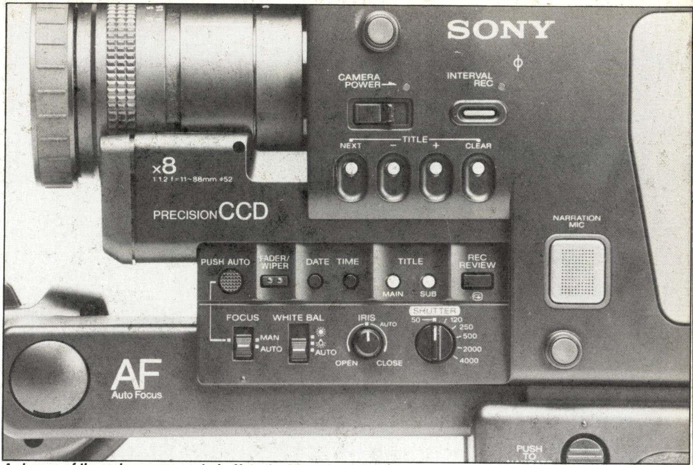
Like the other models in the Sony range, the V200E has an IR auto focussing system. This is very good, too. But like all such systems it can be "fooled" in certain situations – such as rapidly moving subjects, subjects that reflect little infra-red, and subjects that are intangible. To cope with this kind of situation the V200E provides optional manual focussing as well, so you can choose from either. There's even a Push Auto button in the manual focussing mode, to let you try the effect of auto focussing quickly. The lens has a Macro facility, by the way, and will focus down to about 10mm from the front of the lens for super close-ups.

Of course there's the usual white balance switch, which may be set in three positions: Auto, Daylight (5800K) or Indoors (artificial lighting at 3200K). There's also an Iris control, which may be used to alter the lens aperture either way from the auto exposure setting, to cope with tricky lighting situations.

A very nice feature of the V200E and one that is *not* found on most other models is a variable shutter speed control. This has an impressive SIX different possible speeds, from 1/50th of a second (normal speed) up to an extremely fast 1/4000th. This makes it possible to produce very clean and crisp shots even when you're shooting quite rapidly moving subjects like tennis players, golfers or skiers. A very worthwhile feature, particularly if you want to analyse the action later by viewing it frame by frame.

Other features of the V200E camera section include the ability to display and/or record the date and time, maintained by an internal electronic clock/calendar; the ability to prepare and record simple text titles and scene ID frames (in various colours); a fader/wiper button for fades and wipes at the start or end of a scene (the wipes are shrinking/growing rectangles); and an "interval recording" button, to record brief 8-frame bursts of image at 15-second intervals.

Turning now to the video recorder section, this is basically at the rear of the unit and offers all of the usual features as found on the simpler models. Most of the main deck control buttons are behind a small swing-out panel, to protect them from accidental misuse when the camcorder is being used for



A closeup of the main camera controls. Note the 6-speed variable shutter.

Sony V200E camcorder

normal shooting.

You have a choice of either standard play (SP) or long play (LP) recording, the latter giving double the playing time but not quite as good resolution due to the lower tape speed (10.058mm/s vs 20.051mm/s).

Special features of the V200E deck include the ability to have the deck return the tape automatically to the point where the counter was reset to zero; an Insert button, to allow replacing a scene in an existing recording with another; the ability to record 8-frame "single shots"; and the ability to Audio Dub – i.e., to record a new audio track without disturbing the recorded pictures.

Another feature that's really part of the deck section, even though the control button is with the camera controls, is a Record Preview button. This replays the last few seconds of the last scene recorded on the tape, in the viewfinder.

In addition to normal playback of recordings, the V200E also allows pausing for still picture display, and for "slow motion" replay at 1/25th normal speed. There are Still Adj and Frame Adj knobs to obtain the best picture quality in these modes.

The sound side

Now for the *really* impressive part of the V200E – the sound section. And the main thing here is that it gives you the ability to record in full-blown PCM digital stereo. It's just like having a DAT recorder built right inside the camcorder and sharing the same tape!

The sampling rate used for the PCM sound is 31.5kHz - only about 70% that used by compact discs (44.1kHz), but still sufficient to give an audio bandwidth of 20Hz – 15kHz. Rated dynamic range of the Video-8 PCM system is better than 85dB, with wow and flutter less than .005% RMS.

It's important to realise that the V200E doesn't just give you this PCM stereo *instead* of the FM sound (mono) found on the simpler models; it gives you *both*. The FM sound channel is still there, to ensure compatibility with other Video-8 camcorders and VCRs.

In fact the two are largely independent. You can record the main sounds of the scene in stereo on the PCM tracks, while recording a narration or commentary on the FM mono track. And you can later dub new sound onto either, without disturbing the other – very flexible indeed!

There's even a built-in narration mic on the left-hand side of the camera, just near your mouth when the V200E is perched on your right shoulder. All you have to do is press a small button with your left hand, and speak quietly to have your comments recorded on the FM track. There's also a socket for an external narration mic and/or monitoring headset.

To allow for basic stereo recording, the main microphone built into the front of the V200E just above the lens is a fairly directional dual-lobe stereo type, with integral wind shield. It is also provided with a switchable low-frequency filter, to further reduce the effects of wind noise.

Needless to say there's also a pair of sockets for external stereo microphones. Not only that but there are dual RCA-type line input jacks, concentric recording level controls and a pair of recording level meters – a far cry from the usual rather spartan audio facilities found on most camcorders!

In playback mode you can select either the PCM stereo tracks, the FM mono track or a mix of both as desired.

For interfacing to other video/audio equipment, for playback and/or editing, the V200E provides input and output connectors for both video and stereo audio. It also comes with a plug-in RF modulator, to feed the replay signals into a standard TV receiver on the UHF band.

As if this wasn't enough, there are also connectors marked Accessory In and Out, for optional external video processing equipment such as colour correctors, digital video superimposers and so on. Clearly Sony sees the V200E as having much wider applications than amateur movie making!

Trying it out

OK, OK, I hear you ask – enough of the purple prose. How did it actually perform?

Basically very well indeed. To check out the picture section I tried shooting a variety of test subjects: static and moving, close and distant, in a variety of lighting conditions, and with the camera both perched on my shoulder and mounted on my trusty Miller tripod. The results were excellent, as good as any I have seen from the Video-8 format – or from other domestic formats, for that matter. Clean, sharp pictures from the camera, with good white balancing and low noise level even down to quite poor lighting levels.

Checked using a standard test pattern chart, the basic resolution of the camera section seemed to be better than 250 lines, with something over 200 lines evident on replay. But I should stress that this was viewing the pictures via the RF modulator and my typical but well-adjusted TV receiver. You'd almost certainly do somewhat better than this with a direct video connection and a high resolution monitor, especially with the signal direct from the camera. I suspect the camera resolution is rather better than that of the recorder and the RF modulator, thanks to the higher-resolution CCD sensor.

In any case what was noticeably better compared with the cheaper models was the performance on rapidly moving subjects, thanks to those optional fast shutter speeds.

I really liked the Rec Preview button, too – which lets you look at the last few seconds of the previous scene, before you start recording the next. Great for ensuring visual continuity!

On the sound side, the main interest was of course the PCM stereo sound channels. I tried recording both live sound, using the built-in mic, and dubbing test tracks direct from the CD player, using both a test-frequency CD and various music disks that I know are of excellent quality.

The results were very good, although not *quite* as good as I'd hoped.

The frequency response was fine: flat within about 1dB from below 40Hz to about 14kHz, and only 6dB down at 16kHz. The system background noise level was also very low, and as far as I could determine very close to the -85dB quoted in the Sony specs. There was no wow or flutter that I could measure, either – consistent with Sony's figure of .005%. Even though these figures are not quite as good as for CD or DAT (which is what you'd expect, really, with the lower sampling rate), they're still extremely good and well ahead of the performance available on other camcorders or VCRs.

My only real reservation was that on replay of the test frequency tracks – particularly those for the higher frequencies (above 6kHz) – there was a small but distinctly audible *modulation noise* component. A kind of edgy "hiss", only evident when the signals themselves were present.

I first recorded these test tracks at the 0dB level indication on the V200E's level meters, to ensure the best signal to noise ratio. That's when the modulation noise became evident. Thinking that it may be due to slight over-modulation, I tried repeating the recordings all over again at a level of -10dB. It then became a lot less obvious, but was still there.

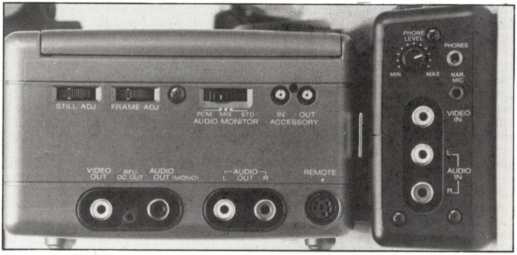
It's possible that this effect was due to a slight misadjustment of the sample unit, of course, but it was a little disappointing. I should add, however, that it really wasn't evident on live recordings or music dubbings – they sounded great. In fact you couldn't tell the difference between the CD "original" and the Video-8 PCM dubbing.

As for all of the features and facilities on the V200E, they were great too. The whole camcorder has a really professional feel about it, with everything you'd want for flexible and creative shooting. A video enthusiast's dream, and I'm sure even a professional camera operator would find it very satisfying to use.

After using it for a few days, I suspect other camcorders are going to seem something of an anticlimax.

You won't be surprised to learn that this prince of camcorders doesn't come cheaply: the basic unit will have a recommended retail price tag of $4999, no less. But that doesn't seem unreasonable when you consider what it gives you compared with the rest.

My thanks to Gary Beauchamp of Sony Australia for the chance to check out this first sample of the CCD-V200E, which should be available from Sony video dealers by the time you read this. EA



Rear view of the 200E on its side, showing most of the inputs and outputs. The main deck controls are under the swing-back panel at the top.

Cordless telephones:

Yuppie toys or necessary tools?

Opinions may differ regarding the value of cordless telephones, but in Australia as elsewhere they're steadily becoming more popular. The latest models offer much more security and privacy than their predecessors, but all models must be rigorously tested before being allowed into the country.

by THOMAS E. KING

Anyone visiting Australia for the first time is likely to get the wrong idea about the country's acceptance of modern telephone technology. Because cordless telephones are near the bottom of an official list of prohibited items, which includes drugs and lethal weapons, it would be easy to believe that the import, sale and use of cordless wonders "Down Under" is forbidden, prohibited and generally not allowed. Like so many other things, however, the truth is not always obvious. As regular EA readers will know, cordless telephones are actually alive and very well in Australia.

The answer to any question about how such devices can be in legal use in this country when Australian Customs includes them in a document of prohibited imports is found when a single word is considered: "standards". All cordless telephones, which must be type approved and issued with a permit to connect, can only be imported by authorised applicants. Any prior to the arrival of commercial quantities of a particular model, a sample unit is inspected by three separate bodies for compliance with individual strict standards.

Any AC mains powered cordless telephone is first required to have approval from an Australian Electrical Authority before it is submitted for a Telecom test. The issue of this approval, however, does not imply that the equipment will satisfy the electrical safety requirements of Telecom.

Number one priority

"Electrical safety of cordless telephones is the number one concern of Telecom," said Reg Cogar, Telecom Australia's Permitted Attachment Liason Officer. Testing for the important safety aspect is followed by tests on system compatibility, system interference and frequency allocation. Telecom conducts its own test for standards relating to these specifics although it liases with the Department of Communications for assessment of the radio aspects of the cordless system. (The operating frequency of approved cordless phones is between 30 and 39MHz.) When found to comply with the requirements of both DOC 302 and Telecom 1358, Telecom issues the Permit to Connect and forwards it concurrently with DOC Type Approval to the applicant.

Telecom stresses that even if equipment is fully approved, "it is preferable that cordless telephone systems incorporate measures to ensure the secrecy of conversations over the radio link". When this is not possible, equipment operating instructions must include a warning that "appropriately tuned radio equipment and other cordless telephone systems in close proximity may be used by a third party to monitor and possibly interrupt conversations in progress when this system is on radio operation."

While many of the previous problems associated with cordless phones (false ringing, radio interference and even electrical safety faults) seem to have been eliminated with the imposition of strict import and safety standards, the lack of privacy is still very much an issue. Despite the major disadvantage that private conversations can be monitored by scanners and other wireless phones, sales are increasing. Consequently, there's no shortage of distributors and retailers wanting the two official "seals of approval".

Full testing facilities

Testing isn't cheap. "The standard fee is $700," said Gary Lawton, Telecom Senior Technical Officer, "and that even applies to an imported overseas cordless telephone with accompanying data sheets claiming to meet Australian specifications. The unit must be tested; we just can't take anyone's word."

The only word that Telecom does take is a signed statement from approved permit holders. This document says that specifications for all units to be imported are the same as the tested unit. If a situation arises where this is not the case, the permit is cancelled and the distributor or retailer can no longer sell a particular model nor connect it to the Public Switched Telephone Network (PSTN). If an unapproved unit is connected to the public network Telecom will, as a last resort, disconnect the line.

Such a stringent system has helped stem the flow of illegally imported and sub-standard cordless phones from reaching land-based consumers.

The situation is somewhat different on water, although the illegal use of high power ship-to-shore radio telephones hasn't developed into a major problem. The occasional transmission may go un-

(Picture courtesy Dick Smith Electronics)

noticed, but the DOC's monitoring service will pinpoint more frequent violators. The paradox is that equipment used illegally in Australian waters was likely to have been legally purchased over the counter in some Asian country.

Best available telephones

While Australian consumers do not have the same range of cordless telephones available to them that can be found on the electronic supermarket shelves of most retailers in Singapore and Hong Kong, there should be some comfort knowing that such apparatus sold in Australia will not damage Telecom lines or indeed users. In any case the selection is growing, as overseas manufacturers produce quality cordless models for our relatively small but expanding market.

Tandy and Dick Smith Electronics have both responded to the needs of the cordless consumer. Both electronic retail giants released new top-of-the-line feature-enhanced units this year.

Tandy's best available cordless phone has a host of features including a 32 list memory of telephone numbers, a security code with 10,000 combinations, intercom facilities and programmable touch tone or pulse dialling, so rotary line users can have access to tone required services. The ET-410 AUS, priced at $329.95 is also hearing aid compatible.

Top of the Dick Smith line is the $349 Callmaster. It features a 250m range and a full paging facility. Several innovations are also seen including provision for a 3-way conversation between the caller, the handset user and the base station user, as well as a 2-channel switch to change radio channels (and avoid interference from other nearby cordless phones). The unit also features an optional plug-in charger so the handset, if needed, can be permanently kept away from the base unit.

Although DSE and Tandy Electronics are among the better known nationwide retailers and mail order outlets for cordless telephones, numerous other stockists can be found in major centres around the country. A good example of a specialist retailer is Phonies, a Sydney-based company which concentrates only on telephone and communication systems.

Buying a cordless

Rebecca Cameron, Manager of Phonies Mid City Centre branch offered a few tips for anyone in the market for cordless communications. Dispelling the myth that consumers want a cordless phone useable over many kilometres, Ms Cameron said that "distance is not a factor. It couldn't be anyway, because 250 metres is the legal limit."

"Consumers," she said, "are far more interested in clarity. They don't like the "tinny" sounds from cheap telephone speakers and are willing to pay more for better audio."

Probably second in the minds of most consumers is security coding. Although cordless phones have been available in Australia since 1982, there were no security coding features until 1984. No one needs to worry about new units sold in 1988 as the better cordless telephones now have 10,000 or more security combinations. But, she noted, some consumers defeat the purpose of security codes by not changing the preset combination that is programmed at the place of manufacture.

Compared to clarity and security, Ms Cameron said that an intercom facility is a distant third point of interest in a decision of what cordless phone to purchase. It is a factor to consider, however, for office use and families with small children.

This monitoring facility (useful for parents in one room and a bedded baby in another) is but one feature of the Hong Kong-made $399 Callmaster Superfone sold by Phonies. The CT-1500 also boasts a melody tune while on hold, 1,000,000 security codes, twin pushbutton dials (one each for the handset and base) and a 30 digit memory for full ISD use.

Greater memory capacity is one relatively recent addition now seen on many cordless phones available in this country. So what else is ahead for the convenience conscious cordless consumer?

The cordless future

Additional features and cosmetic improvements seem to be the direction of the immediate future, with more memory capacity, better quality audio systems as well as some changes in design and perhaps a wider colour range. Some of this new technology has been integrated into relatively newly released machines.

Hatadi Pearce-Simpson seems to be the first company to release a useful telecommunications hybrid: a cordless telephone incorporating a telephone answering machine. Featuring a twin cassette deck, beeperless remote control, call screening and even record time selection, the all-Australian company is marketing the unit for the individual in the home or office who definitely doesn't want to miss an important call. The Pearce-Simpson Walkabout MK2AUS is a relatively new entry on the personal telecommunications scene.

Another innovative product has yet to be released at the time of writing, although consumers are expected to be able to take advantage of the major benefit of Dick Smith Electronics' newest cordless telephone in July or August. Following on line with the company's policy of being the first to launch new products onto the Australian market is its waterproof cordless telephone.

Immediate application of this $300 convenience with its approximate 100 metre range is in high humidity situations such as kitchens and saunas, where there is considerable moisture. Apart from that this new phone is guaranteed to work even after it's been dropped in the pool. (Try that just once with any other cordless telephone!) This latest electronic wonder from DSE is certain to have a ready made market from status seekers and yuppie executives wanting to make those all-important, first-of-the day telephone calls from the comfort of their showers!

Australian breakthrough:

Airborne CO_2 laser searches for minerals

An Australian team of scientists working at the CSIRO has produced what is believed to be the first practical "active" airborne remote sensing system for minerals, based on a carbon dioxide infra-red laser which is rapidly tuned over 100 different frequencies every three milliseconds. It's a breakthrough that could revolutionise mineral exploration world wide.

by JIM ROWE

In the old days, minerals were discovered by prospectors who plodded through the mountains and deserts on foot or horseback, chipping off lumps of likely looking ore with their trusty rock hammer. It usually took many months, and even then there was no guarantee of success.

Nowadays, of course, mineral exploration companies can't afford to wait this long. They also need to be fairly sure the mineral(s) they're after are present in a particular area – at least to a reasonable extent – before sending *anyone* out there in earnest.

The only real way of meeting these requirements is by scanning an area from the sky, using a satellite or aircraft fitted with instruments which can *remotely sense* the presence of the minerals you're interested in.

Satellite remote sensing using visible and near-infrared sunlight reflected by the earth is a very useful technique used by exploration companies. Research groups often use similar instrumentation but mounted in an aircraft, to get a closer look at the earth – i.e., better "spatial resolution".

Another standard technique that is used from aircraft is to use very sensitive magnetometers, which can detect the way large deposits of magnetic minerals such as iron, nickel and cobalt distort the earth's magnetic field.

However none of the techniques mentioned so far is very good for identifying and distinguishing silicate and carbonate minerals — the principal constituents of rocks! As it happens the surface distribution of such simple minerals often gives important clues to where there may be hidden ore bodies well below the surface.

It turns out that silicates and carbonates can be quite reliably detected and distinguished using mid-infrared radiation. Here each of these minerals tends to absorb a different combination of wavelengths. So that the mid-IR energy reflected and/or radiated from each kind of mineral tends to have a characteristic spectral "fingerprint", capable of being used to reveal its presence.

The wavelengths required for this type of remote sensing are in the vicinity of 10um (micrometres), corresponding to frequencies around 30 terahertz (30,000GHz). This is right in the middle of the 8-14um "atmospheric window", where the earth's atmosphere itself is relatively transparent to IR radiation – fairly important if you're trying to detect things from a distance.

The problem with *passive* sensing using the mid-IR is that the sun is a much weaker source of illumination at these relatively long wavelengths. So much so that when we "look" at the earth in the mid-IR region of the electromagnetic spectrum, we actually see more *emitted* radiation from the earth (as a black body at 300K) than reflected radiation from the sun (as a very distant 6000K illuminating source).

The emission from the earth is so weak that in order to detect it, you are forced to collect it over wide wavelength/frequency bands before feeding it to detectors – in order to overcome noise. The result is fairly poor spectral (or "colour") resolution.

An additional problem with looking at emitted radiation is that its strength depends not only on the actual emitting ability of the surface concerned, but on its *temperature*. So temperature variations due to "shadowing" by mountains and hills give rise to ambiguities in the measured "emittance".

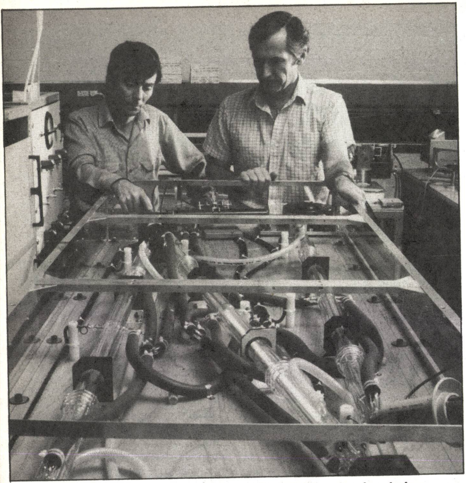
By the way the *emittance* of a body (at a particular wavelength, and in a certain direction) is a measure of its ability to radiate energy, compared with a hypothetical "black body". Theoretically this is also equivalent to its *absorptance*, or ability to absorb incident energy under the same conditions. On the other hand its *reflectance* is its ability to reflect incident energy, and not absorb it.

Since energy that isn't absorbed must be reflected, absorptance and reflectance are basically the opposite sides of the same coin. A good absorber/emitter is a poor reflector, and vice-versa. So emittance and reflectance are each as good as the other for measuring the mid-IR spectral "fingerprint" mentioned above.

Active sensing

Rather than rely on passive sensing, a much more satisfactory approach would be to scan the ground with a source of relatively high intensity radiation at each of the mid-IR wavelengths of interest, and at the same time measure the rather stronger reflected energy that this would produce. This is the concept of *active* remote sensing.

The only catch is that to do it, you need a fairly high powered source of mid-IR energy, and one that can be carried in an aircraft along with its source of power. If that wasn't enough, it also has to be capable of being rapidly tuned to each of the mid-IR wavelengths of



CSIRO scientists Lew Whitbourn (left) and Dick Phillips showing during testing of the laser's power supply and current control systems before the telescope optics were added. The rotating polygon mirror is just under Dick Phillips' hand, with the output end of the laser just out of picture at bottom left.

interest. Either that or you'd need a separate source for each wavelength, which would be even more difficult...

At present, the most promising source of reasonable power at mid-IR wavelengths is the CO_2 (carbon dioxide) laser. But traditionally CO_2 lasers are quite large, and require bulky power supplies and auxiliary equipment for cooling and gas supply. Not the sort of thing that would be suitable for airborne operation, you'd think.

Up until recently the usual CO_2 laser has been seen as a relatively fixed-wavelength device, too. Great for pumping out large amounts of energy on a particular wavelength, for applications like cutting and drilling, but not at first sight the best choice for something that must be switched rapidly between many different wavelengths.

In short, the CO_2 laser normally seems more the strong but lumbering elephant of the mid-IR generating world, rather than a lean and agile gazelle!

But it turns out that the lumbering CO_2 juggernaut really is capable of what's needed for airborne IR remote sensing, after all. The elephant *can* be taught to perform aerial acrobatics, and the scientists who have played a leading role in discovering how to teach it these new tricks are right here in Australia, working in our very own but oft-beleaguered CSIRO.

Over the last 20 years, teams of scientists throughout the world have tried a variety of different ways to get various kinds of CO_2 laser to produce pulses of output energy in a broad range of mid-IR wavelengths. But until a couple of years ago, none of these attempts had been very successful in producing a source of the kind best suited for remote sensing. Some managed to produce output pulses of high enough power, but only on a few wavelengths; others to produce lasing on many different wavelengths, but not rapidly enough. No one seemed to be able to combine the two.

It was only in 1986 that a team of Australian scientists, working in the CSIRO's divisions of Mineral Engineering and Exploration Geoscience (as they are now called), made the first breakthrough. John Eberhardt, Andy Green and their colleagues were able to show that a 3-metre long CO_2 laser using longitudinal discharge excitation, could be tuned rapidly over many different wavelengths using a rotating mirror polygon and diffraction grating. They also showed that it could be made to produce sufficient output power on all wavelengths by running it continuously at a low level, but then pulsing the excitation to a higher level just before and during each burst of pulses. (I'll try to explain the operating details shortly).

They managed to get the laser to produce output pulses on 92 different wavelengths in the 9 – 11um range, with an average pulse power of 370 watts and at a rate of 90 multi-wavelength pulse bursts per second. This was a much more promising result than had ever been achieved previously, and although quite a few practical problems remained to be solved, it showed that the idea of using a CO_2 laser for active remote sensing was likely to be feasible.

Since then John Eberhardt, John Haub and Lew Whitbourn have done further work at the CSIRO to refine and improve the basic technique, and late last year they managed to produce a CO_2 laser setup which could reliably tune through 110 different wavelengths between 9.2 and 11.1um, in as little as 3 milliseconds and with pulse output power levels ranging from 100 to 500 watts. It could also repeat these bursts at rates up to 360Hz – more than sufficient (in terms of both power and tuning rate) to allow remote sensing from an aircraft flying at 500m altitude, and a speed of 150 knots.

Work then began on adapting this laser to produce a complete remote sensing system, capable of being carried in the CSIRO research aircraft, an F-27 Fokker "Friendship". This work is being carried out by a team led by Dr Lew Whitbourn, working for CSIRO's Division of Exploration Science and based at the National Measurement Laboratory in Lindfield, a leafy northern suburb of Sydney.

At the time of writing, work on the system is almost completed and it is due to be taken on its first test flight in early July, about the same time you'll be reading this article. If all goes well, it will be the first really practical airborne active mid-IR remote mineral sensing system ever produced. ▷

Assuming Dr Whitbourn and his team are successful, this achievement has the potential to revolutionise mineral exploration not only in Australia, but throughout the world.

In typical "modest Aussie scientist" tradition, Dr Whitbourn is quick to point out that any success achieved by his current team will have been built on a foundation of the results achieved by the earlier workers. Such is the nature of most scientific and technological achievement, I guess. But all the same, it's nice to see Australian scientists playing such a key role at the leading edge of technology.

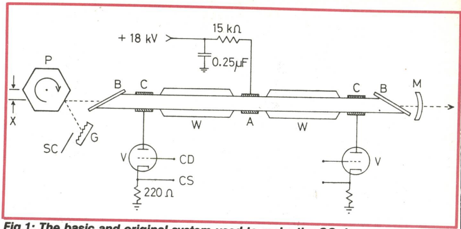


Fig.1: The basic and original system used to make the CO_2 laser produce a rapidly tuned series of high power pulses.

How it's done

For those who would like to know more about how the system works, I'll now try to explain. Dr Whitbourn was kind enough to spend quite a few hours explaining it all to me, and I think at least the basic principles sank in (if they didn't, it will be my fault rather than his!). So here goes:

The basic and original arrangement used for the tuned CO_2 laser is shown in Fig.1. The main laser tube is in the centre; this is made from Pyrex glass, and is fitted with water jackets (W) for cooling. The tube is 3 metres long and 15mm in internal diameter and contains a mixture of CO_2, N_2 (nitrogen) and He (helium) in the proportions 1:1:2, at a pressure of about 1.6 kilopascals.

The energy which excites the CO_2 molecules to achieve lasing action comes from an electrical discharge longitudinally (lengthwise) along the tube, between a centre ring anode A and the two end ring cathodes C. The anode is connected to a source of +18kV DC, while the cathodes connect to the negative "earthy" rail via two valves V, used to control the discharge current (and hence the laser's level of excitation).

At each end of the laser tube is a Brewster window (B), made from common salt (NaCl) crystal. These are fitted at an angle such that for the IR wavelengths concerned, they are almost lossless.

At the output end, outside the tube, there is a convex mirror M, made from germanium and arranged so that it reflects around 95% of the mid-IR energy back into the tube (to sustain lasing), but transmits the remaining 5%.

The beam emerging from the other end of the tube meets the polished facets of a rotating polygon P. This can rotate at between 450 and 3600rpm, and has highly polished facets with a special coating for enhanced reflectivity at mid-IR wavelengths.

As each facet rotates across the axis of the beam, it reflects it to diffraction grating G. The grating is made from gold-coated stainless steel, and has 150 linear grooves per millimetre, running at right angles to the direction in which the beam scans across them.

It is the action of scanning the beam across the grating, via each polygon facet, which effectively tunes the laser to each of the desired output wavelengths.

The grooves of the grating have a size and pitch (about 6.6um) such that at the mid-IR wavelengths concerned, they act rather like a large broadside "array" of reflectors. And because of this, the grating has an interesting property: for each particular wavelength, if the beam strikes the grating at a certain critical angle, almost all of its energy will be reflected back *in the same direction*. Not reflected away, as with a normal mirror, but straight back. And this only happens at one particular angle of incidence, for each wavelength.

Needless to say as the polygon scans the beam across the grating, the angle between beam and grating changes. So at each instant during the scan the grating will be potentially a very efficient retro-reflector for one particular wavelength, related to the instantaneous angle between beam and grating.

With this kind of laser, there are potentially many different wavelength "lines" on which it can operate and produce output energy, in the mid-IR range. Each of these corresponds to photons of a particular energy, produced by transitions of CO_2 molecules between specific pairs of vibration-rotational energy levels, among the many that are available in the excited gas discharge.

Which of these potential wavelengths the laser actually produces depends basically on the "loop gain" in the laser's optical path. And naturally enough this loop gain will be a maximum at the wavelength which is currently able to bounce back and forth over the entire laser path, including the polygon and grating. In other words, the wavelength at which the path is *resonant*.

Actually because of the way in which the polygon and grating setup works, the loop gain at all other wavelengths will be very low indeed – because the energy doesn't even return into the laser at all!

So as each facet of the rotating polygon sweeps the laser beam along the grating, its effect is to "tune" the resonant frequency of the optical path through each of the potential output wavelengths which can be produced by excited CO_2 molecules, in the mid-IR band.

As a result, each sweep of a polygon facet produces a complete "burst" or series of brief output pulses from the laser, with each pulse on a different wavelength. A typical burst of pulses is

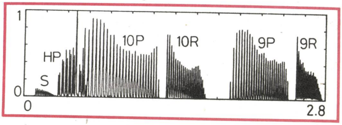


Fig.2: A typical burst of pulses produced by the laser, at wavelengths from 9.2 to 11.1um, in less than 2.8 milliseconds.

shown in Fig.2. Each burst lasts about 2.8ms (for a polygon speed of 450rpm), with the individual pulses lasting around 10us, on wavelengths between 9.2 and 11.1um.

To allow the CO_2 laser to produce sufficient power in such a rapid series of short pulses on different wavelengths, the discharge excitation must be applied continuously. This is because true pulsed operation of a CO_2 laser requires the use of very high excitation levels, to ensure that it turns "on" quickly. But when very high excitation levels are used, this tends to cause the creation of an *arc* in the discharge tube, shortly after lasing begins. This stops the lasing, but it is then very difficult to quench the arc and let the gas cool down rapidly enough to repeat the process at the pulse rates and power levels necessary for remote sensing.

However applying full excitation continuously is also counterproductive, because the gas gets too hot and "over excited" (with lower energy levels highly populated as well as the higher levels). The solution is to run the excitation continuously at a low "idling" level, and only switch it to the full power or "bright up" level for slightly longer than the duration of each burst of pulses.

This is done by controlling the laser's current control valves V, using a current drive signal CD synchronised to the rotating polygon. So that just before each polygon facet reaches the correct angular position for the start of its burst of pulses, the valves increase the laser excitation current from 10mA up to 50mA. The reverse occurs just after the end of the burst.

By switching to full excitation just *before* the start of each burst, a strong "population inversion" of CO_2 molecules in excited energy levels is created inside the laser's discharge. Because of this the laser can produce a very strong pulse of mid-IR energy, as soon as the polygon facet and grating swing the laser's tuning through the first available output wavelength.

This energy-storage-and-rapid-release mechanism is known as *Q-switching*, and is what gives the CO_2 laser its high pulse output power. It also tends to occur for the individual pulses in each burst, due to the time gaps between the pulses on each wavelength. So much for the basic CO_2 laser and the way it has been adapted for rapidly-tuned multi wavelength operation. Now let's look at the actual construction, and the way it's being used for airborne remote sensing.

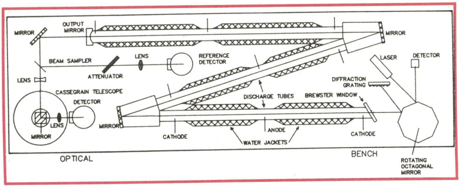


Fig.3 (above): A plan view of the final setup, with the laser "folded" into a Z shape. The telescope is at the lower left. The smaller laser at centre right is used to monitor the exact position of the rotating polygon.

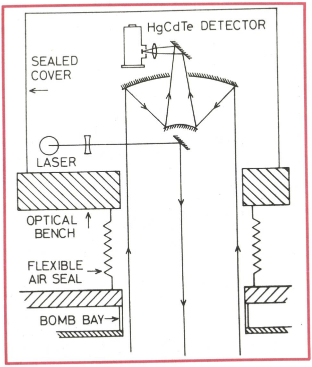


Fig.4: Side view of the "business end" of the system, showing the laser output mirror and the receiving telescope. Both "view" the ground via the aircraft's open bomb bay.

Fig.3 shows a plan view of the setup, which differs in a number of ways from the prototype of Fig.1. The first thing to notice is that to make it more compact, the laser tube itself has been "folded" into a Z shape, using additional mirrors. Each of the three legs of the tube has its own set of discharge electrodes, and its own water cooling jackets. The laser's main partially transparent output mirror is now also mounted directly on the end of the output leg, obviating the need for a second Brewster window.

Both the remaining Brewster window and the output mirror are now made from ZnSe (zinc selenide). This is to avoid the potential problems in airborne operation likely to be caused by NaCl, which is very hygroscopic.

The rotating polygon and diffraction grating are at the other end of the laser as before, so that apart from the laser tube being folded, very little has changed. The small laser and detector also shown associated with the polygon are used to generate the timing reference for the main laser's "bright up" control pulses.

The output pulses from the laser are directed by a 45° mirror through a ZnSe lens, and then to another mirror which directs them down through the bomb bay of the aircraft towards the ground (see Fig.4). A small amount of the outgoing energy is also tapped from the output beam via a 45° sampling plate, passed through an attenuator and lens, and fed to a reference detector. This is used to monitor the exact amplitude and timing of all transmitted pulses, for maximum accuracy.

The reference detector is a photoconductive HgCdTe (mercury-cadmium-tellurium) element 1mm square, cooled by liquid nitrogen at 77K (-196°C). This gives it a good signal-to-noise ratio.

The optical characteristics of the overall mid-IR transmitting system are such that when it is in an aircraft flying at an altitude of 500 metres, the beam width or scanning "footprint" on the ground is

2m in diameter. Under these conditions the intensity of IR radiation on the ground is very safe, being at least 60 times smaller than the safety levels for direct viewing in this band, as specified by safety authorities.

As you can see from Fig.4, the mid-IR energy reflected back to the aircraft from the ground is collected by an IR telescope, of traditional Cassegrain construction. This was designed by laser optics expert Dr Michael Waterworth, of the University of Tasmania, and made by Tasmanian firm Longmans Optics. The concave 300mm primary mirror and convex 100mm secondary mirror are both made from aluminium coated borosilicate glass (Duran), and give the telescope an aperture of F/0.83.

At the rear of the telescope the received pulses are focussed via a 45° mirror and 30mm diameter ZnSe lens onto the receiving detector, a second 1mm-square HgCdTe detector operating at 77K. The output signal from this detector is of course the one of prime interest, representing as it does the IR spectral "picture" of the ground footprint currently being sensed.

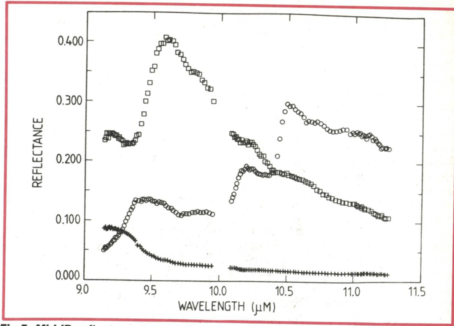


Fig.5: Mid-IR reflectance spectra produced by silicate minerals.

Data processing

The data recording and analysing system basically records both the amplitude and timing of all transmitted and received pulses, on a continuous basis.

For each individual wavelength pulse, the transmitted pulse monitored by the reference detector is first digitised by a 12-bit ADC (analog to digital converter), triggered by a peak detector. Then about 3 microseconds later, corresponding to the aircraft-ground-aircraft round trip propagation time, a second 12-bit ADC connected to the receiving detector is also triggered, to digitise the returned pulse. In each case the exact timing of the pulses is also registered, providing a total of four items of information: two amplitudes and two times.

This sequence is repeated for each pulse in the repetitive bursts. So for each burst of 100-odd pulses, there will be roughly 400 items of digital information. The two streams of digital data are recorded on a streaming tape cassette, for later analysis on the ground. Each streaming tape cassette stores 60 megabytes of information, corresponding to approximately one hour of sensing data.

When the data is later analysed, the ratios of transmitted and received pulse amplitudes are compared for each wavelength, to give a dynamic picture of the ground surface in terms of its reflection of mid-IR energy. This will then allow identification of the minerals present on the surface.

Examples of the kinds of IR reflectance spectra produced by different common minerals are shown in Figs.5 and 6. Fig.5 shows the spectra produced by silicate minerals such as plagioclase (squares), olivine (circles) and silica (crosses), while Fig.6 shows those produced by carbonate minerals such as dolomite (crosses), magnesite (circles) and calcite (squares). As you can see, each type of mineral tends to produce a characteristic spectrum.

I hope that gives you at least a basic idea of how the new active remote infra-red sensing system works. Dr Whitbourn tells me that as the technique is refined and more experience is gained in its use, there may well be much wider applications than sensing for minerals. It could also be useful for sensing different kinds of vegetation, for example.

In short, it seems to have a very promising future, if things turn out as planned.

Let's hope everything works out well in those first airborne tests, scheduled for about the time you'll be reading this issue!

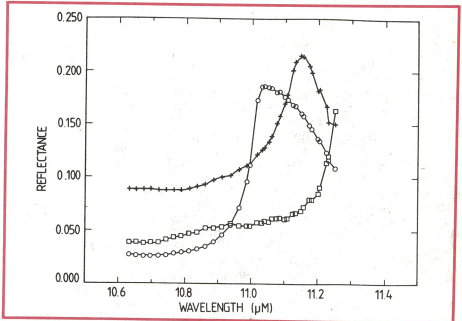


Fig.6: For comparison, reflectance spectra produced by carbonates.

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Ron Bell of RCS Radio:

'Been there; done that!'

In 1932, a young and ambitious R.A. (Ronnie) Bell decided to sever his connection with the Weingott brothers and their fledgling Kriesler Radio and to 'give it a go' on his own, manufacturing a range of tuning coils, IF and power transformers, chokes and wirewound resistors. Ron is now in his twilight years but the company he founded, RCS Radio, is still actively serving the needs of *EA* readers.

Ron Bell in 1934, taken from an old issue of Wireless Weekly.

by NEVILLE WILLIAMS

At the time when Ron Bell launched RCS, I myself was still at school, in the crystal set stage. But it wasn't too long before our paths converged and I found myself using and specifying in print the kind of components which Ron was busily marketing for local radio enthusiasts. RCS Radio is still a regular advertiser in the magazine, although now under the guidance of Bob Barnes and occupied mainly with printed circuit boards and front panels.

Never one to claim an in-depth knowledge of wireless/radio/electronic theory, Ron nevertheless had an undoubted entrepreneurial flair and an impressive skill when it came to matters mechanical. For the most part, he used that skill not to achieve 'the ultimate' in mechanical refinement, but to create components that would do the job – at an affordable price.

To have watched the progress of Ron Bell and his company is one thing, but to recount it as a piece of local electronics history is quite another. It is fortunate, however, that between them, the present proprietor Bob Barnes and Ron's wife Olga were able to come up with a yellowed scrapbook and a very yellowed RCS Sales & Service Manual, pertaining to the early years. Not all the clippings are adequately credited and dated, but they certainly proved helpful in piecing the story together.

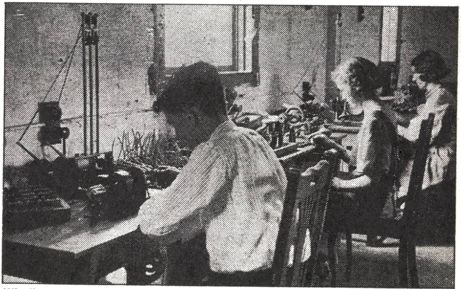
I recall some speculation in the early days as to whether the initials RCS were inspired by the high profile American electronics company's initials 'RCA', but in fact RCS is an abbreviation of the title 'Radio Components Sydney'. The letters always were – and still are – officially separated by full points in formal documents: viz R.C.S.

The new company set up in 1932 had its first head office and factory at 12 City Road, in Sydney. But it soon became necessary to move to larger premises nearby, at 21 Ivy St, Darlington – an address that mistakenly appeared in some clippings as Redfern and Chippendale, adjacent inner suburbs. Hopefully postmen of the era were less confused than the magazine writers!

Of the early RCS sales managers referred to in the clippings, one Ralph Kelsey left for posterity a typically Australian quote, that must surely have appealed to the Paul Hogan-style larrikin element in Ron Bell. Just back from an unlikely visit to Menindee in outback NSW, Ralph described it as 'a place where kangaroos sleep under the near side of a barbwire fence, to shelter from the rain that never falls!'

Early product lines

As with other manufacturers, most of the early RCS tuning coils were wound



Winding coils at the Ivy Street, Darlington factory in 1934. A contemporary story noted that the factory could turn out 'several thousand coil units per day', with 40 different types of coil.

Front view of the Darlington factory, which was gutted by fire in July 1938.

on Marquis(?) 1-1/4" (32mm) diameter, hard bakelite formers, supported by three legs on a base mounting ring. The windings were variously wound with enamel-, cotton- or silk-covered wire, then lacquered or dipped in hot paraffin wax. What moisture it didn't seal out in those early days, it probably sealed in!

To assemblers in radio factories, the particular coils presented an all-to-familiar problem – that of mounting them reliably to the chassis and shield with, usually, 1/8" Whitworth brass bolts. Too little tension and they would work loose; too much and the brittle base ring would fracture – hopefully without being noticed by the inspector! There was a sigh of relief all round when hard bakelite formers ultimately gave place to impregnated paper, with pressed metal supports and terminals.

As a measure of the activity of RCS in that early formative period, the Sales and Service Manual referred to earlier contains the circuits and specifications of nearly 50 do-it-yourself projects, drawn mainly from *EA's* predecessor *Wireless Weekly* and including large and small battery and mains receivers, amplifiers and short-wave converters, all based on RCS kits and components. By any standards, it was an impressive lineup.

In 1934, RCS further expanded its product range with a 3-band RF 'signal generator' for servicmen and enthusiasts. More correctly it was a modulated oscillator, covering the broadcast band and the two then-popular intermediate frequencies of 175kHz and 460kHz. This was followed by a matching attenuator and output meter and a line of replacement loudspeaker transformers – a very necessary item at the time, because speaker transformers were possibly the single most frequent cause of receiver breakdown.

In the following year, the ever astute Ron B. noted the rising problem with electrical interference with ordinary broadcast reception. In those days, the field strength from the stations was nothing like it is today and the rapidly proliferating electrical appliances in homes were largely without any form of interference suppression. Matching the thought to the deed, Ron set about manufacturing and marketing a large and profitable range of RF suppression chokes, line filters, wave traps – and a complete anti-noise outdoor aerial kit.

At about the same time, with a rapidly rising interest in short-wave reception, he began to develop dual-wave coil kits for domestic superhets, along with a wide selection of small bits and pieces – lugs, tagstrips, brackets and so on.

Cars and speedboats

As a business executive, in all this, Ron Bell must have been doing something right, to judge by the number of references in the trade press to his passion for big American cars, especially big Pontiacs. He owned them, loved them and occasionally bent them in his hurry to get from point A to point B!

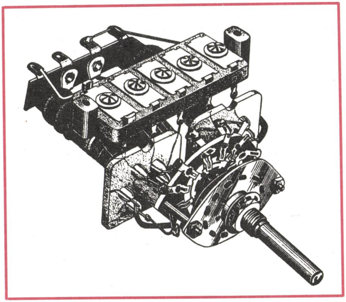
Those were the days when the ultimate driving achievement, it seemed, was to break the Sydney/Melbourne record – an activity that was ultimately banned.

At one time or another, most of Ron's cars were fitted out with 2-way radio amateur gear, with Ron being one of an industry group which spent many a weekend in the mountains overlooking Sydney, seeking favourable sites for long distance transmission on the 5m (6MHz) amateur band. (See *EA*, Aug.'87, p.28). Other well-known identities in the group included John Moyle (*Wireless Weekly*), Rae Weingott (Kriesler), Jack Paton (Lekmek), Harry Norville (Breville) and Don Knock (*Radio World*).

To cap off his interest in amateur (and not-so-amateur) radio, Ron had an

Ron Bell (left) pictured with Wireless Weekly/Radio & Hobbies editor John Moyle, in the late 1930s.

A dual-wave coil unit made by RCS in the early 1950s, especially for the Radio & Hobbies 'Advance 1952 Radiogram'. It provided all RF coils, trimmers and switching for both broadcast and short-wave bands.

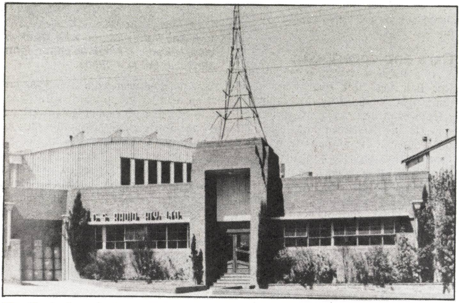


A group of RCS employees photographed outside the rear of the Darlington factory, in the late 1930s.

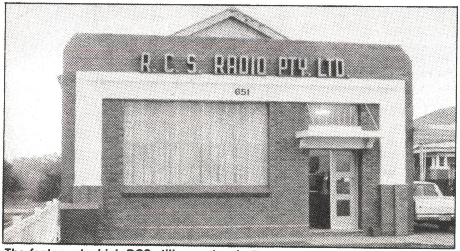
80ft (25m) self-supporting 'research' tower erected behind his home in Dulwich Hill, in Sydney's inner west – surely the largest tower ever in a private suburban garden. Resting in concrete foundations 8ft (2.5m) deep, the four corners were/are 12ft (3.6m) apart, while the associated 'shack', 'den' or 'laboratory' in the house was crammed with equipment which most enthusiasts could only dream about. Many were the arguments, official and otherwise, as to whether its owner was a legitimate amateur – or something else.

They were arguments which Ron preferred to ignore. He just chuckled and carried right on!

Ron was also passionately fond of speedboats, with frequent snippets in the trade press about his exploits with 'RCS Radio', 'Miss RCS' and 'Miss Olga', the last named after an attractive Olga Higlett, who subsequently became his wife. During one such outing, he ran under a rope at speed and was lucky to escape with his head still on his shoulders!



The Canterbury factory – impressive but ill fated. It's now a shoe factory.



The factory at which RCS still operates, in Bexley.

Factory gutted

An informal photograph, taken circa June '37 shows a staff of 26, posed in aprons and dustcoats, outside the Darlington factory. But just 12 months later the complex was gutted by fire, which completely destroyed the manufacturing and testing facilities, along with stock ready for despatch.

As it had not been fully covered by insurance, first impression was that RCS had been wiped out. But less than three weeks later, on July 8, 1938, the *Wireless Weekly* Trade Supplement reported that the company had resumed operation from temporary premises at 50 Glebe Rd, Glebe.

In fact, the fire seems to have provided a challenge for the company, with its acquisition of plant from the long-established 'Radiokes' group and an arrangement by which RCS would henceforth manufacture Radiokes components on an OEM basis, for Radiokes founder Keith Stokes. RCS was also reported to hold an interest in other component supply companies but, asked about these arrangements, Ron Bell's normal response was, again, a disarming chuckle.

Trolitul coil formers

1939 saw a completely new range of RCS and Radiokes components injection moulded from Trolitul, a clear but easily tinted synthetic thermo-plastic hydrocarbon material. Tough and stable, with very low electrical loss and largely impervious to moisture, Trolitul was well suited to the mass production of coils and IF transformers – apart from an inconveniently low melting point.

RCS was reported to have solved the latter problem with a 'special high melting point formulation', although some claimed that it was simply using plated steel pins with a lower thermal conductivity. Characteristically, Ron chose not to comment one way or the other!

Meanwhile his pride and joy, a new factory at 174 Canterbury Rd, Canterbury was taking shape. I was shown through just after it opened and, while I cannot now recall many of the details, his enthusiasm was similar to that of Dick Smith, many years later, when he was showing off his new headquarters at North Ryde. The facilities and staff amenities had all been planned and agreed upon from the outset. RCS management and staff would henceforth be one big happy family.

But it didn't work out that way. Apparently there were industrial problems, and Ron Bell gradually came to the conclusion that there had to be an easier way to earn his kind of living than by distributing a large product range from a large modern factory with a large modern staff! Bliss must surely be a small factory and a limited product range, produced on automated equipment by as few people as possible. Better still – by nobody in particular!

Growing smaller

So, in June '47, Ron Bell granted AWA an option to purchase the Canterbury factory and transferred his activities to much smaller premises at 651 Forest Rd, Bexley. But more about that later.

In their enthusiasm, Ron and Olga had also decided to build the holiday home/weekender of their dreams – at the base of a bushland cliff, right on the waterfront in Sydney's Pittwater. It was an ambitious project, with both of them knocking off work every weekend to carry bricks – literally.

And so it came together: a large entertainment area overlooking Pittwater, living quarters just above water level, a marine radio communications centre, a sea-water pool, a jetty and cruiser out front, a Chriscraft in the boathouse and an electric runabout moored nearby. And down the face of the cliff, an electrically powered truck on steel rails as yet another indicator of Ron Bell's mechanical flair.

Facing Christmas 1948 (if memory serves me correctly). Ron rang me to suggest that he and Olga had the holiday house, and we had children. Maybe we could spend Christmas together – which we ultimately did, and a very pleasant Christmas it turned out to be. But we certainly weren't alone. As Ron and Olga were to discover, a small army of friends and acquaintances from the electronics industry and a home, pool and jetty fronting Pittwater is hardly the formula for quiet, restful weekends.

There comes a time when even the most gracious hosts have to call it quits. A time to say: 'Been there; done that!'

PC boards

Back at the small Bexley factory, Ron Bell set about winding down the impressive array of stock items in which he had become involved. This allowed him to concentrate on an area which presented a new and interesting challenge to his mechanical skills: automated production of printed circuit boards.

His long-term dream: to produce a machine which could be fed with sensitised and photographically exposed boards at one end and which would deliver completed boards at the other, without the intervention of skilled labour and without the need for staff to cope with raw chemicals or fumes.

Ron worked out the principles based on 11 years of accumulated experience with traditional methods. He then designed the machine itself and constructed it on the spot. It was announced and pictured in the July '72 issue of *EA*. I quote:

'The machine etches, washes, removes resist, washes again, neutralises, final washes and dries the boards, producing completed boards ready for drilling at rates up to 600/hour'.

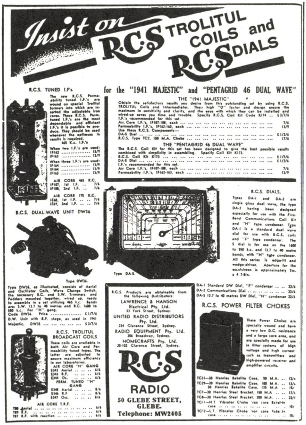
During the machine's construction, Ron apparently dubbed it 'Herbie'. I gather that everyone knew it by that name for the rest of its working life.

In fact it is only now, 16 years later, that Bob Barnes is dismantling Herbie to make way for new high-tech (and high priced) equipment. Something that's quite a tribute to Ron Bell's mechanical flair, in itself.

Also noteworthy is the fact that Bob Barnes still prefers to use Ron's original PCB photoresist printing machine, in preference to much more recent commercial models. As Bob says, 'It simply works better, and more reliably!'

Somehow, the current advert for RCS Radio Pty. Ltd. catches the vision and resourcefulness of its founder: 'Established 1933... the only company which manufactures and sells every PCB and front panel published in EA and ETI'. ⓔ

An RCS advertisement from the April 1941 issue of Radio & Hobbies, showing the range of products made and marketed by the firm at that time.



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The R.C.S. Coil Kit for this set has been designed to give the best possible results combined with simplicity in assembling. Specify Coil Kit K173.
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DISTORTION: 1KHz ‹0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)›92dB flat ›100dB A-weighted, MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected: ›86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal: ›71dB flat ›75dB A-weighted.

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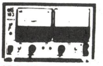

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Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.
***Note:** The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display!
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SPECIFICATIONS:
Accuracy: 0.1% + −1 count
Linearity: + −1 count
Samples/sec: 3
Temp. Stability: 50 ppm typical
Temp. Range: 0 - 50∘C
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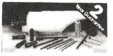

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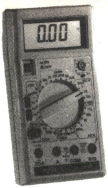
Y16008 .... **$8.95**

NEW!

U.S. PCB MOUNTING TELEPHONE SOCKETS

4 WAY: 4 Slot, 4 pins wired, small size.
6 WAY: 6 Slot, 6 pins wired, medium size.

Cat.No.	1-9	10+
Y16008 (4 Way)		$2.60
Y16009 (6 Way)		$2.95



METEX M-3650 MULTIMETER

20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

This spectacular, rugged and compact DMM has a bright yellow high impact plastic case. It features a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement and comprehensive AC/DC voltage, current and resistance ranges.

CHECK THESE FEATURES....

- Push-button ON/OFF switch.
- Audible continuity test
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD.
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 .... Normally $165
Special, only $149

METEX 4500H MULTIMETER

10A, 4½ digit multimeter with digital hold, transistor tester and audible continuity tester.

The Metex 4500H is perfect for the technician, engineer or enthusiast who requires the higher accuracy of a 4½ digit multimeter. This meter is exceptionally accurate, (just look at the specifications), and yet, still retains an exceptionally low price!

The Metex 4500H features digital hold which is normally only found on very expensive multimeters. This enables you take a reading and hold that reading on display even after you have removed the probes, simply by pressing the hold button.

CHECK THESE FEATURES...

- Readout hold
- Transistor Tester
- 4½ digit x ½"(H) LCD
- Audible continuity tester
- Push-button ON/OFF switch.
- Quality set of probes
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- Built in tilting bail
- Instruction manual
- Full overload protection
- hFE test
- Battery and Spare fuse
- Diode Tester
- Vinyl case

Q91560 .... Normally $175
Special, only $159

MIDRANGE HORNS

Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30 watts RMS, in a system they will handle over 100 watts RMS.

Two sizes to choose from:
Size: 4"x 10½"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 1.5kHz - 14 kHz
Dimensions: 102 x 267 x 177mm
Cat. C92082 **Normally $49.95**
This month only $39.95

Size: 3"x 7"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 2kHz - 15 kHz
Dimensions: 76 x 177 x 145mm
Cat. C92084 **Normally $29.95**
This month only $24.95

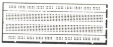
Dealers, OEM's, etc., phone (03) 543 2166 for wholesale prices

WELLER WTCPN SOLDERING STATION

The WTCPN Features:

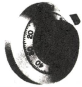
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having.
Cat. T12500 .... **R.R.P. $149**
SPECIAL, ONLY $129



TAKE 25% OFF THESE BREADBOARDS THIS MONTH ONLY!

Cat. No.	Description	Price
P11000	100 Holes	$ 2.75
P11005	640 Holes	$10.75
P11007	640 · 100 Holes	$14.95
P11009	640 · 200 Holes	$17.50
P11010	1280 · 100 Holes	$26.95
P11011	1280 · 300 Holes	$32.50
P11012	1280 · 400 Holes	$39.95
P11015	1920 · 500 Holes	$59.95
P11018	2560 · 700 Holes	$69.95



20% OFF THE PRICE OF SPECTROL MULTIDIALS

MODEL 15-1-11

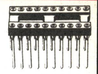
Number of turns: 10
Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (¼")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1¾")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)
Cat.R14405 .... **$45.95**
SPECIAL, $35.95

MODEL 16-1-11

Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (¼")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)
Cat.R14400 .... **$26.95**
SPECIAL, $21.50

MODEL 21-1-11

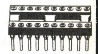
Number of turns: 15
Minor Scale Division: 1/100 turn
Shaft Bore: 6.35mm (¼")
Finish: Satin Chrome
Body Size: 46.04mm diameter (1.812")
Depth: 25.4mm (1")
Weight: 85.g (3oz.)
Cat.R14410 .... **$46.95**
SPECIAL, $37.50



WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

Cat.No.	Description		1-9	
P10579	8	pin	$1.50	$1
P10580	14	pin	$1.85	$1
P10585	16	pin	$1.95	$1
P10587	18	pin	$1.95	$1
P10590	20	pin	$2.95	$2
P10592	22	pin	$2.95	$2
P10594	24	pin	$3.95	$3
P10596	28	pin	$3.95	$3
P10598	40	pin	$4.95	$4



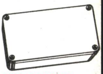
LOW PROFILE IC SOCKETS

Save a small fortune on these "Di Import" low profile IC sockets! PC mounting solder tail. Dual wipe. A plated phosphor bronze or berryll and dual wipe for reliability.

Cat.No.	Description	1-9	1
P10550	8 pin	$0.20	$0
P10560	14 pin	$0.25	$0
P10565	16 pin	$0.35	$0
P10567	18 pin	$0.40	$0
P10568	20 pin	$0.40	$0
P10569	22 pin	$0.40	$0
P10570	24 pin	$0.40	$0
P10572	28 pin	$0.50	$0
P10575	40 pin	$0.50	$0

TEXTOOL SOCKETS

P17016	16 pin	$14.9
P17024	24 pin	$18.5
P17028	28 pin	$24.9
P17040	40 pin	$29.5



DIECAST BOXES

Diecast boxes are excellent for RF shielding, and strength.
Screws are provided with each bo

H11451	100 x 50 x 25mm	$ 5.9
H11452	110 x 60 x 30mm	$ 6.5
H11453	120 x 65 x 40mm	$ 6.9
H11461	120 x 94 x 53mm	$11.5
H11462	188 x 120 x 78mm	$13.5
H11464	188 x 188 x 64mm	$29.5

POCKET SIZE BATTERY TESTER

- Tests all 9V to 1·5V batteries including button cells.
- Arms extend to various battery size
- Easy to read meter.
- Requires no power source.

M23521 .... **$11.9**

HORWOOD ALUMINIUM CASES

H10382	3 x 4 x 2 inches	$ 5.50
H10383	3 x 4 x 3 inches	$ 6.50
H10384	3 x 4 x 4 inches	$ 7.50
H10385	3 x 4 x 5 inches	$ 7.95
H10386	3 x 4 x 6 inches	$ 8.50
H10387	3 x 4 x 7 inches	$ 9.50
H10388	3 x 4 x 8 inches	$10.50
H10389	3 x 4 x 9 inches	$10.95
H10390	3 x 4 x 10 inches	$11.95

ROD IRVING ELECTRONICS WE'VE GOT IT ALL INCLUDING DISCOUNT PRICES

D TO CAR CASSETTE STEREO ADAPTOR

bles a portable CD player or
able TV to be played through any
speaker system by using the cars
ette player. Reduces the risk of
. Just plug in when required, and
ove when you are finished. Hard
g not needed.
0011 .... **$29.95**

QUALITY 3mm LEDS

No. Col.	1-9	10+	100+
140 Red	**$0.15**	**$0.12**	**$0.10**
141 Grn	**$0.20**	**$0.15**	**$0.12**
143 Ylw	**$0.20**	**$0.15**	**$0.12**
145 Ora	**$0.20**	**$0.15**	**$0.12**

QUALITY 5mm LEDS

No. Col.	1-9	10+	100+
150 Red	**$0.08**	**$0.07**	**$0.06**
151 Grn	**$0.15**	**$0.12**	**$0.10**
152 Ylw	**$0.15**	**$0.12**	**$0.10**

10mm JUMBO LED's

0155	Red ...	**$1.00**	**$0.90**
0156	Green	**$1.00**	**$0.90**
0157	Yellow	**$1.00**	**$0.90**

EATSINK COMPOUND

atsink compound is applied to the
e and mounting studs of
nsistors and diodes. It maintains
ositive heatsink seal that
proves heat transfer from the
ice to the heatsink, thus
reasing overall efficiency.

. H11800 (10g)	**$2.95**
. H11810 (150g)	**$17.50**

A. SPEAKERS

w dual cone, wide range
0mm (8in.). Ideal for public
dress, background music.
c. Tremendous Value at these
ces! Cat.C12000
9 10+
5.95 **$5.95**

KEY SWITCHES

1-9 10+
t. S12500 .... Normally $7.95
9 10+ 25+
.95ea $4.25ea $3.95ea

OOK UP WIRE

at. No. Description
11251 13/.12 TND BLK
11252 13/.12 TLD BROWN
11253 13/.12 TLD ORANGE
11254 13/.12 TLD YELLOW
11255 13/.12 TLD GREEN
11256 13/.12 TLD BLUE
11257 13/.12 TLD WHITE
PRICES PER 100 METRE ROLL
9 10+
5.95 **$5.00**

11260 14/.20 RED
11261 14/.20 BLACK
11265 14/.20 BLUE
11268 14/.20 WHITE
PRICES PER 100 METRE ROLL
9 10+
12.00 **$10.00**

11270 24/.20 RED
11272 24/.20 BLACK
11274 24/.20 GREEN
PRICES PER 100 METRE ROLL
9 10+
14.00 **$12.00**

11280 32/.2 BROWN
11282 32/.2 BLUE
PRICES PER 100 METRE ROLL
9 10+
20.00 **$18.00**

COMPONENT BARGAINS!!

MC1488	$0.60
MC1489	$0.60
UA3086	$0.50
LM339 or U339	$0.50
8255	$2.50
8279	$2.50
6821	$1.50
74LS253	$0.35
74LS258	$0.35
74LS293	$0.35
74LS273	$0.60
74F00	$0.25
74S00	$0.25
74S175	$0.50
7405	$0.20
7416	$0.20
7445	$0.40
7473	$0.30
7474	$0.20
7493	$0.20
74123	$0.20
74154	$0.60
IN4004 (per 100)	$3.00
IN4148 (per 100)	$1.00
BU326A	$2.00
7404	$0.20
7406	$0.20
8237-5	$1.50
8259	$1.75
8156	$1.75
8279	$1.75
8212	$1.75
8085	$3.00
26LS31	$2.50
26LS32	$2.50
FND507	$1.00
NE5534	$1.50
LM3915	$2.50
LM3914	$2.50
7812KC	$1.20
MN3001	$3.00
7818KC	$1.00
DS3691	$2.00
WD1791	$3.00
WD1691	$3.00
Z80ASIO	$3.00
7818UC	$0.50
MC13020P	$2.00
2SJ49	$6.95
2SK134	$5.95
ZN429	$29.50

RECHARGEABLE 12V 1·2AH GELL BATTERY

Leakproof, long service life batteries ideal for security systems, emergency lighting or as a computer backup power supply, etc.

Cat. S15029 ...... **Normally $19.95**
1-9 10+
$13.95 **$12.95**

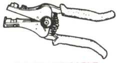
CD PLAYER ADAPTOR

Many amplifiers have only one auxiliary input. This makes using a compact disk player as well as another auxiliary input inconvenient. Also the majority of CD players have an output voltage of 1·6 or 2 volts whereas the auxiliary input norm is 750mV. This CD adaptor allows dual auxiliary input, and one input has variable gain setting.

SPECIFICATIONS:

- Input 2 sets of 2 x RCA sockets
- Gain 150, 300, 600mV, 1V and 2V
- Output 2 x RCA sockets

A11510 .... **$23.95**



AUTOMATIC CABLE STRIPPER

- Strips cable with diameter of 1 1·6 2 2·6 3·2mm
- Fully automatic action. Squeeze grip will simulataneously strip and eject insulation.
- Length 180mm (7")

T11532 .... **$19.95**

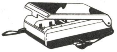
CANNON TYPE CONNECTORS

Cat.	Description	1-9	10+
P10960	3 PIN LINE MALE.	**$3.90**	**$3.50**
P10962	3 PIN CHASIS MALE	**$3.00**	**$2.50**
P10964	3 PIN LINE FEMALE	**$4.50**	**$3.90**
P10966	3 PIN CHASIS FEMALE	**$4.95**	**$3.95**

NICADS!

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

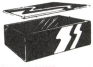
Size	Desc.	1-9	10+	100+
AA	450 mA.H.	**$2.95**	**$2.75**	**$2.50**
C	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**
D	1.2 A.H.	**$9.95**	**$9.50**	**$8.95**



SUPER DELUXE BATTERY CHARGER

- Charges from 1 to 10 D, C, AA, AAA, N, and up to 3 x 9V batteries at the same time.
- Dual colour LED in first three compartments to designate 1·5V or 9V.
- 240V AC/50Hz.
- Approval No. N10637

Cat.M23525 .... **$59.95**



UTILITY BOXES

Plastic boxes with aluminium tops, and available in four sizes. Very popular for projects and very ecconomical!

H10101	150x90x50mm	**$ 3.25**
H10102	195x113x60mm	**$ 4.50**
H10103	130x68x41mm	**$ 2.75**
H10105	83x54x28mm	**$ 1.95**
H10110	120x65x38mm	**$ 2.95**
H10112	120x65x38mm (Metal top)	**$ 2.95**

DESOLDERING BRAID

1.5 metres at direct import prices!

Cat.No.	1-9	10+
T11230	**$1.75**	**$1.50**

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	**$9.95**	**$8.95**
2156 240V 6-15V 2A Cat. M12156	**$14.95**	**$13.95**
2840 240V 9V CT Cat. M12840	**$5.95**	**$4.95**
2851 240V 12-6V CT 150mA Cat. M12851	**$5.95**	**$5.50**
2860 240V 15V CT 250mA Cat. M12860	**$5.95**	**$4.95**
6672 240V 15-30V 1A tapped Cat. M16672	**$14.95**	**$13.95**

10W HORN SPEAKERS

White durable plastic. 8 ohms
Cat. C12010 **Normally $11.95**
1-9 10+
$7.95 **$6.95**

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).

Features include:

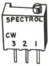
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

WITHOUT TIMER

Cat. X14950 .... **Normally $97**
Special, $79

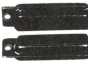
WITH BUILT-IN TIMER

Cat. X14955 .... **$139**
Special, $99



SPECTROL 64Y MULTI TURN TRIMPOTS

Cat.No.	Description	1-9	10+
R14700	10R	**$3.50**	**$3.20**
R14710	20R	**$3.50**	**$3.20**
R14720	50R	**$3.50**	**$3.20**
R14730	100R	**$3.50**	**$3.20**
R14740	200R	**$3.50**	**$3.20**
R14750	500R	**$3.50**	**$3.20**
R14760	1K	**$3.50**	**$3.20**
R14770	2K	**$3.50**	**$3.20**
R14780	5K	**$3.50**	**$3.20**
R14790	10K	**$3.50**	**$3.20**
R14800	20K	**$3.50**	**$3.20**
R14810	50K	**$3.50**	**$3.20**
R14820	100K	**$3.50**	**$3.20**
R14830	200K	**$3.50**	**$3.20**
R14840	500K	**$3.50**	**$3.20**
R14850	1M	**$3.50**	**$3.20**

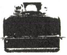


DB25 CONNECTOR SPECIALS!

TYPE	1-9	10+	100+
9P	$0.70	$0.60	$0.50
9S	$0.70	$0.60	$0.50
9C	$0.60	$0.50	$0.40
15P	$0.70	$0.65	$0.60
15S	$0.70	$0.65	$0.60
15C	$0.70	$0.60	$0.50
25P	$0.70	$0.60	$0.50
25S	$0.75	$0.65	$0.60
25C	$0.70	$0.60	$0.50

DB 25 CRIMP SPECIALS!

Type	1-9	10+	100+
Female	**$2.95**	**$2.50**	**$1.95**
Male....	**$2.95**	**$2.50**	**$1.95**



CENTRONICS SOLDER PLUGS SPECIALS!

1-9	10+	100+
$2.95	**$2.50**	**$1.95**

COUNTER

12V DC. 2 watt. 10 C.P.S.
Cat. Q11300 .... **$17.95**

10 AMP RELAY

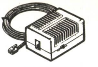
S.P.D.T. 12V Coil, 240V ... (S14114)

1-9	10+	100+
$4.95	**$3.95**	**$3.75**

HIGH EFFICIENCY RADIAL FIN HEATSINK

Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency.
Designed by Rod Irving.

H10520	105 x 30mm	**$ 3.50**
H10525	105 x 75mm	**$ 4.95**
H10529	105 x 100mm	**$ 5.50**
H10534	105 x 140mm	**$ 7.90**
H10535	105 x 150mm	**$ 8.90**
H10538	105 x 170mm	**$ 9.95**
H10542	105 x 195mm	**$10.95**
H10543	105 x 200mm	**$10.95**
H10546	105 x 225mm	**$11.95**
H10549	105 x 300mm	**$12.95**
H10560	105 x 600mm	**$26.95**



TELEPHONE EXTENSION BELL

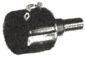
- 10 metre length extension cord.
- Features US type plug
- Use with US/Australian adaptor

Y16043 .... **$25.95**

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for laser disc players to get that fantastic sound quality.

Plug Cat. P10151	**$2.95**
Socket Cat. P10150	**$2.25**



10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534
¼" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9 10+
$9.95 **$9.50**

rie

Rod Irving Electronics

MELBOURNE: 48 A'Beckett St.
Phone (03) 663 6151

NORTHCOTE: 425 High St.
Phone (03) 489 8866

CLAYTON: 56 Renver Rd.
Phone (03) 543 7877

SOUTH AUSTRALIA:
Electronic Discounters P/L,
305 Morphett St, ADELAIDE
Phone (08) 212 1799
NOTE: (Prices may vary interstate due to freight costs)

MAIL ORDER:
Local Orders: (03) 543 7877
Interstate Orders: (008) 33 5757
All Inquiries: (03) 543 7877

CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938
Fax: (03) 543 2648

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
(STRICTLY ORDERS ONLY)

LOCAL ORDERS
& INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1	$9.99	$2.00
$10	$24.99	$3.00
$25	$49.99	$4.00
$50	$99.99	$5.00
$100	$199	$7.50
$200	$499	$10.00
$500 plus		$12.50

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What's happening in Stereoscopic 3D-TV

Stereoscopic 3D-TV

Stereoscopic 3D-TV

Is full stereoscopic three-dimensional TV in natural colours just around the corner? Here's a look at the current state of the technology, with a rundown on how the various systems work.

by GEOFF BAINS

It is difficult to believe that 50 years ago the public first saw broadcast television pictures in fuzzy, patchy black and white and thought it was all quite wonderful.

As each television advance arrives, it is soon accepted as the norm and taken for granted.

TV has indeed come a long way. Higher definition and colour are now well established. Yet better definition is currently being argued over, and stereo sound is already making headway in some parts of the world. However, the next truly great leap forward in TV technology will be the advent of stereoscopic, 3-dimensional TV.

3D TV is still just a gleam in many a researcher's eye. But come it will and then we shall all look on the flat, lifeless repeats of today's programmes with the same amusement we currently reserve for silent movies.

Of course, the first true 3D TV will only come when equipment such as the conventional TV screen itself can be discarded. Few science fiction views of domestic screens in the future don't include a holographic TV playing a genuine 3-dimensional, solid, walk-around image in the corner of the living room.

However, holography is now in a similar state of advancement as was TV technology at the time of John Logie Baird's experiments with weird and wonderful mechanical scanning systems. One day the science fiction may well come true, but for the moment we have plenty of more achievable dreams to contend with.

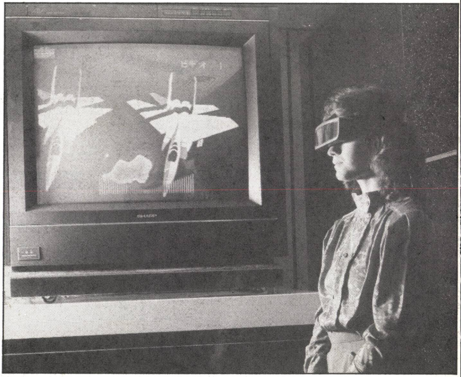
As yet, there isn't one standard, nor even a single way forward, for 3D TV. Research in many countries is following almost as many attacks, but a few select methods have come to the fore.

The international broadcasting standards body, the CCIR, has laid down what it considers the essentials of any 3D TV system. These basically say a 3D system must provide a natural depth 3-dimensional 'picture' viewable by a group from any reasonable angle without discomfort to the viewers.

In addition, it is hoped that stereoscopic transmissions would require a minimum of alterations to and compatibility with the present standards. A future 3D receiver should display 2D transmissions correctly and present receivers should be able to show 2D renditions of 3D transmissions without alteration.

A tall order, but some progress has already been made.

To present a stereo image, a 3D TV system must provide each eye of the



Sharp's stereoscopic TV system, which provides full colour reproduction. The glasses use LCD optical switching.

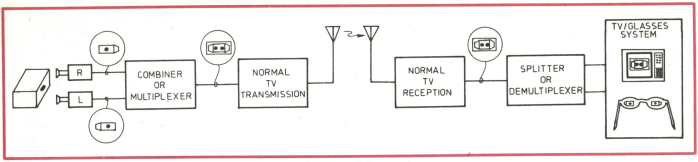
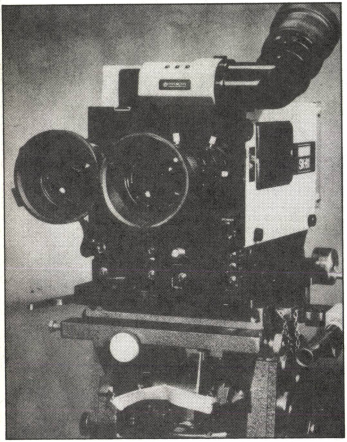


Fig.1: The basic requirements for a stereoscopic or '3D' television system.



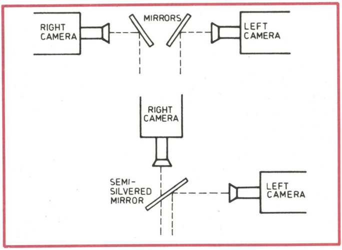


Fig.2 (above): Two different ways of making a pair of bulky TV cameras 'view' a scene as if they were spaced like human eyes.

Left: Two Hitachi SK-81 cameras combined, as used for the IRT 3DTV system.

viewer with a view of the scene 'taken' from a slightly different viewpoint (Fig.1). The human brain, being a clever organ, combines the two views into one and calculates the relative positions of all the objects by some lightning trigonometry.

Virtually all 3D TV systems currently developed use a pair of TV cameras with the lenses separated by the same distance as the human eyes, to provide the two images. The physical size of professional TV cameras can make this a little tricky, but various ways have been adopted to get around this problem. (Fig.2).

That's the easy part. The hard part of course comes when the two images are to be presented, each to the correct eye, in the viewer's home.

The simplest system uses the same method beloved by the early 3D cinema films. The two images are separated, or coded, by colour. A red filter is placed in front of one stereo camera lens and a green filter in front of the other.

The two images are simply added together and broadcast to a normal colour TV set. The viewer wears glasses with red and green filters in the two lens and so each eye receives the correct image only.

The problem with this 'red-green anaglyph' method is that the quality of picture is pretty lousy and, although the brain makes a brave attempt at determining the colour of the original scene, it can never really succeed.

More importantly, the brain is not really used to seeing different colours with each eye and soon gets tired.

Nevertheless, the TVS station in England ran a series of films and specially produced science programs a few years back using the red-green anaglyph method, with suitable glasses given away with a TV listings magazine. These programmes were quite successful (although a little confusing to viewers unaware of the experiment) and showed the red-green anaglyph method to be a useful stop gap for occasional broadcasts until a better system is developed.

Instead of colour to separate the stereoscopic images, much modern research is concentrated on polarisation discrimination. The IRT West German institute for research into TV and radio has near-perfected a polarisation method of 3D TV.

Stereoscopic images are recorded without any form of filtering and displayed on a single projection screen TV with polarisation filters placed in front of each projector lens, one to allow through only light polarised horizontally and the other only vertically polarised light.

The viewer then wears glasses with polarised lenses, arranged with vertical polarisation for one eye and horizontal for the other.

This system achieves similar quality and depth of image as does the red-green anaglyph method, but does not affect the colour of the image so the public expectation of full colour can be met.

More importantly for longer programmes, the human eye cannot detect polarisation of light and so the brain is not 'aware' that the two eyes are being treated any differently from normal (any more than wearing a pair of 'Polaroid' sunglasses). So, the polarisation discrimination method is not tiring to any noticeable extend.

An added advantage is the removal of the left-right colour graduation of the projected image found with normal (2D) single projector systems by reversing the order of the red, green and blue tubes of the second projector.

However, the vertical and horizontal polarisation of the spectacle lens means that head movement is restricted without losing the stereoscopic effect. Lean your head in your hand when watching this kind of 3D TV and the images can be reversed, going to the wrong eye. That can give a very strange effect to the film being shown!

Nevertheless, research with clockwise and anticlockwise circular polarised filters is under way, and should solve that problem.

Moreover, this method cannot practically be applied to normal non-projection TV receivers. Although projection based small screen TVs are a possibility one day, this factor does reduce the chances of this method of 3D TV coming into our homes in the near future.

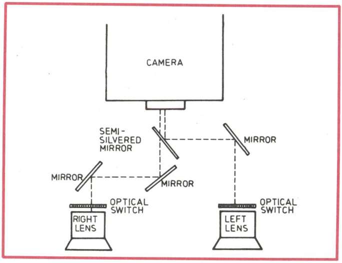
The recently released Toshiba 3D video camcorder, which has twin CCD image sensors and uses standard VHS-C video cassettes.

Transmission of such pictures also requires two TV channels to be used. The frequency spectrum is already overpacked in most countries.

Although the introduction of higher frequency, wider bandwidth spectrums (for cable and satellite TV) may allow stereoscopic TV transmissions of this type, even the IRT engineers consider the expense of the equipment needed for recording, transmission and receiving the transmissions will prevent regular broadcasts for a good many years yet.

The current favourite Australian system (the Maxwell system) also has polarisation at its heart, but relies on time division multiplexing for separation of the two images and so requires a single TV channel.

This time, the stereoscopic camera is much simpler. Only one actual camera is used, with two lens separated at the correct distance with a system of mir-



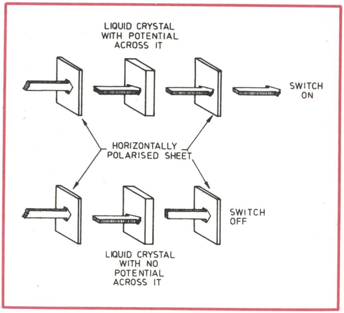

LIQUID CRYSTAL WITH POTENTIAL ACROSS IT
SWITCH ON
HORIZONTALLY POLARISED SHEET
SWITCH OFF
LIQUID CRYSTAL WITH NO POTENTIAL ACROSS IT

Fig.3 (above): The Maxwell system uses a single camera, with optical switching.

Fig.4 (right): How liquid-crystal optical switches operate.

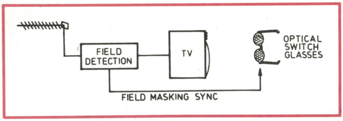
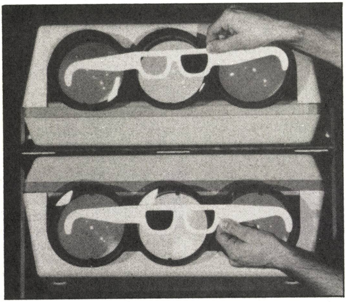


Fig.5: The field-sequential system being developed in Japan.



The IRT system uses two projectors, with oppositely polarised filters. The glasses have matching filters.

rors to combine the image from each lens and direct it at the camera tube (Fig.3).

Associated with each lens is an 'optical switch'. These consist of a plate of field effect transmissive liquid crystal sandwiched between polarising plastic (Fig.4). The liquid crystal naturally rotates the polarisation of light passing though it by 90 degrees but when a potential is applied across the crystal the light passes through unaffected.

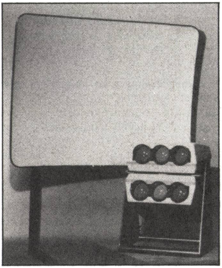
By activating the optical switches alternately, the camera records the left and right images in a successive stream – usually one image for each 'field' period of the TV system.

At the receiving end, the TV has a special screen of the liquid crystal in front of the screen. This is activated in synchronisation with the field sync signal to rotate the polarisation of, say, the right hand image to vertical and the left to horizontal. The viewer again wears the polarised spectacles and each eye sees the correct image, from the *relatively* unmodified TV set.

Quite apart from the same problems of head movement affecting the stereoscopic image, this system currently has one great drawback. At the moment there is no way of manufacturing liquid crystal screens big enough for domestic TV sets. One day, no doubt, this problem will be cracked — but until then this is a system just for the laboratory.

The Japanese, of course, have the last word. The system largely adopted by the research labs there is the closest to domestic reality (Fig.5).

The Japanese system also uses time division multiplexing of the signal to separate the left and right images in a single TV transmission signal. The recording is made using the Maxwell two lensed camera.



The IRT system is really only suitable for projection TV, as shown here. This seems likely to restrict its future.

The receiving TV set is completely unaltered but for an output providing a field synchronisation signal. This is fed to special glasses worn by each viewer. The glasses contain the same liquid crystal optical switches as are used in stereoscopic camera, and blank out each eye so the other receives the correct image as it appears on the screen.

Already Sharp and JVC have demonstrated video recorders equipped with the 'field-masking' synchronising signal output showing specially recorded material. The effect is truly stunning.

One problem is that the TV picture is seen through the glasses to flicker at 25Hz, rather than the normal 50Hz. This is much more noticeable as a flicker and can make the system tiring to use after a while. However, it suffers from none of the head movement or special receiver problems of the other systems and the colour is perfectly natural.

Indeed, with the addition of local powering of the glasses (the LCD shutters require very little power — like a watch, a small battery would do) and transmission of the field-masking signal by infra-red or radio from the set or adaptor, this would appear to offer the near perfect system.

Even the flicker problem looks likely to be simply overcome. Siemens is already offering a chip set for TV manufacturers which doubles the frame rate of normal televisions (by digitally sampling and storing the analog TV signal and 'replaying' it at 100Hz – twice the normal rate).

This system applied to the 3D TV sets would provide stereoscopic images, each at the accepted 50Hz. Future developments along the same lines are likely to offer even faster frame rates, and so give less flicker for 3D TV than we accept for normal TV today.

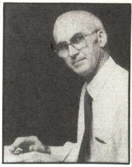
The first sign of this technology is already appearing – not for TV itself but for video games. Sega's latest video game system employs a pair of liquid crystal glasses flipped in time with computer generated stereoscopic pairs of images. Combined with a 'light gun' type control, shooting the marauding aliens has never been so real or so much fun!

There is little in the Sega system which could not be applied now to television.

The technology is all there and the price is reasonable at around $60 (Australian) for the glasses. It is just a matter of time before the TV stations are recording and broadcasting in 3D. Stay tuned to this channel!

FORUM

Conducted by Jim Rowe



"That's all very well, but you've missed the point..."

I've tried to deal with most points of view in my recent discussions of subjects like project kit problems and amplifier earthing complications, but there are always the letters that arrive too late, and those who for various reasons still aren't satisfied. Here's another go at rounding off those particular topics, by discussing points raised by the stragglers and authors of follow-up missives.

Actually the first letter is not from a "straggler" at all, but from a reader who wrote early in January, in response to my piece in the January issue about problems with projects and kits that don't work. By rights I should have discussed his letter and the points he raised in the follow-up piece in the April issue, but as I noted near the end of that column, it had been mislaid.

When I was writing the April column I could clearly remember that the letter had arrived, and that it had been rather critical of the points I'd raised previously – but as for the letter itself, it seemed to have evaporated (sounds suspicious, doesn't it?). It was all very embarrassing. All I could do was 'fess up, and ask the reader concerned to send in another copy if that was possible.

Luckily the reader concerned *did* read my little confession, and was good enough to send in another copy. So the least I can do now is give him a fair go – right?

The reader in question was Mr Don Jackson of Pakenham in Victoria, and as I recalled he certainly had been fairly critical. His opening shot read as follows:

I am afraid I must take issue with you over your Forum article in January 1988, on both of your assertions that neither the magazine nor the kitset supplier should take any blame. Your analogy between the doctor and the chemist is not tenable either, especially as you note (incorrectly) that the pharmacist cannot be held responsible "providing he made it up with the ingredients specified." In that regard I understand that if a pharmacist makes up and delivers a prescription, knowing that an error is included, he is equally liable with the doctor who prescribed.

Be that as it may, and bearing in mind that most of your readers are hobbyists and not professional electronics engineers or technicians, I believe that there is a joint responsibility between you both.

Cop that! Perhaps Mr Jackson is right about my pharmacist analogy being inappropriate, although if the law does hold the phamacist equally liable, it seems to me this would be based on an implied assumption that the pharmacist has all of the knowledge and training of the doctor (in order to know if and when an error was being made). And if that were the case, pharmacists would presumably be able to set up in medical practice, and increase their income!

"Should we publish corrections as soon as possible, or later on?"

I imagine that in any case it would be almost impossible to prove that the pharmacist *knew* that an error was being made, if this kind of situation occurred.

But getting back to electronics and kits, Mr Jackson proceeds by supporting his contention that the magazine should accept some of the responsibility, thus:

There have been many kit designs published where there have been a whole series of errata published, sometimes even in the first month after the design appears. These can range from an error on the printed circuit board, to parts wrongly listed or not listed at all, to parts changes to rectify problems that have appeared after the first lot of kits have been assembled. Sometimes these changes do not appear for several months, and I often wonder is that due to the popularity of a particular kit.

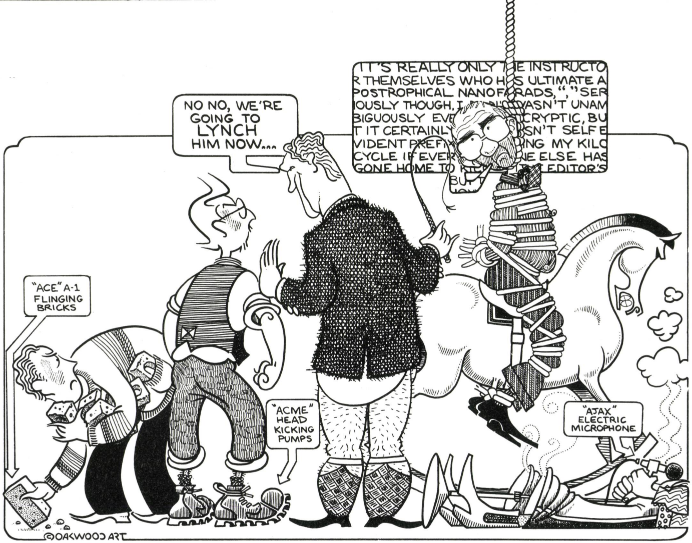
It may seem a bit pedantic, but I feel my first response to him here is to point out that magazines like *EA* don't publish *kit* designs. We publish designs for electronic projects, for which kit suppliers may choose to market kits, and some constructors may choose to build the project up from a kit. But there is a clear distinction between the project design, and any corresponding kit which may be marketed and bought.

Perhaps I also need to stress here again that the magazine only sells the project design information. We do not sell either parts or kits.

Of course he's right that we do make mistakes from time to time in our articles presenting project designs, as I admitted in the original column. And when we discover these errors, we hasten to let all interested parties know. This obviously implies a responsibility, which we accept, to correct any errors in the published design wherever possible.

What I can't quite follow from this section of Mr Jackson's letter is whether he believes we should publish details of design errors as soon as possible, or somewhat later. In fact he seems to be at the same time criticising us for sometimes publishing them too quickly (the very next month), and sometimes not for several months. How's that for having us either way!

What we do endeavour to do is prepare notes and errata for publication as soon as any errors or problems are found, so that they can be published in the next available issue. The idea being to advise everyone as soon as possible, to correct the situation before any harm is done. Sometimes the mistake may happen to be discovered in time for the correction to be published in the next issue, even though it may be too late to correct the original article.


NO NO, WE'RE GOING TO LYNCH HIM NOW...
IT'S REALLY ONLY T E INSTRUCTOR THEMSELVES WHO H S ULTIMATE APOSTROPHICAL NANOF RADS, "," SERIOUSLY THOUGH, I ASN'T UNAMBIGUOUSLY EVE CRYPTIC, BUT IT CERTAINLY SN'T SELF EVIDENT PREFI ING MY KILOCYCLE IF EVER NE ELSE HAS GONE HOME TO KI EDITOR'S BU
"ACE" A-1 FLINGING BRICKS
"ACME" HEAD KICKING PUMPS
"AJAX" ELECTRIC MICROPHONE
©OAKWOOD ART

I can't imagine any situation where we would deliberately delay advising everyone of an error. Mr Jackson's suggestion that we would do so simply because the kit for a project was popular is not only wrong, but illogical. It wouldn't do *us* any good, because we don't sell kits; in fact it would do us a lot of harm, because the longer the delay until people found out about the problem and its solution, the more likely they would have struck trouble with our project design. And the more popular the project, the larger the number of unhappy people!

Needless to say we try not to make errors in the first place, but given our limited resources and the need to develop and publish most of our project designs in a single month, it's very difficult to prevent them occurring now and again.

Having presented his points about the magazine's responsibilities, Mr Jackson proceeds then to deal with the kit suppliers:

The kitset supplier cannot be spared of criticism either. Many of the items in the "Information Centre" section of the magazine deal with kits where the supplier has supplied parts not specified in the original article... This isn't so bad where full documentation of the modification is included, but often it isn't.

I can quote my own case as a hobbyist, where I built an EA Frequency Counter from a kit supplied by one of your major advertisers and found two transistors included which were quoted in a slip as being direct rcplacements for the originals. But they did not work, simply for the reason that the pins were configured differently to the originals. Not having access to a transistor manual, it took a long time for me to find the problem which could have been easily remedied by the supplier including on the slip the information that the base-emitter leads were transposed on the two different transistors.

In another case, having read glowing reports of a transceiver kit, I purchased one some 12 months ago, and have still not got it going. Both a professional engineer in the RF field and a senior technician in the same field have questioned the design itself in one area, but apparently some builders have got them going – although I haven't personally met one yet. Admittedly I haven't tried very hard; I'll just keep plugging along on my own.

Again he has raised some valid points. If component supply problems force kit suppliers to substitute for the parts specified in a published design – which does occur, and probably inevitably – they certainly do have a responsibility to advise the kit buyer both that a change has been made, and of any ramifications of that change.

They also have a responsibility to ensure that any substitute parts supplied are indeed true functional equivalents of the originals, in the design concerned.

I'm sure the kit suppliers themselves would happily agree with both these points, at least in principle – even though it's true that like the magazines, they're guilty of letting errors and omissions slip through from time to time. They and their staff are human, too.

So Mr Jackson has pointed out areas of responsibility for both the magazines and the kit suppliers. Fair enough; I don't think anyone would argue that we don't each have our responsibilities to the reader and kit buyer. We undoubtedly should make every effort to ensure that our designs are capable of working as described, and the kit supplier should make the same effort to provide a suitable kit of parts – either exactly as specified, or the equivalent.

However despite these points I still stand by my original contention that it is the project builders themselves who must accept prime responsibility if it ultimately doesn't work. That's because you're the only one who knows your own ability to assemble the bit of electronic gear concerned, and get it going. And you're the one who made the decision to build it, based on this knowledge, instead of buying something ready made off the shelf.

We magazines certainly have to make every effort to publish designs without errors, and to correct any errors that may slip through, as soon as we become aware of them. We also have a responsibility to offer help and advice regarding problems with our designs, whenever we can. But after all's said and done, we're basically only publishing *interesting information*, for the benefit of those capable of putting it to use. We can't really guarantee that anyone who decides to build up one of our designs will automatically end up with a piece of gear that works perfectly. No one could do this, because there are simply too many variables beyond our control.

It's the same with the kit suppliers. They in turn certainly have a responsibility to ensure that the parts they supply are either as specified, or functional equivalents. But that's really where their responsibility must end, because again there are too many variables outside their control.

You see the point I'm making? It's really only the constructor who has ultimate control over many of the variables in this situation, so that's where the ultimate responsibility must lie too.

I know it sounds a bit glib and smacks of buck-passing, but it's not meant that way. We magazines value our readers highly, because we depend upon you for our survival. But if you were to try forcing us to take full responsibility for the success of every project design we describe, regardless of all other factors, that couldn't be done. You'd simply force all magazines to stop describing construction projects, forthwith.

Similarly although the kit suppliers depend upon kit sales for much of their livelihood, if they too were forced to accept responsibility for ultimate kit success, that too would be unrealistic. They'd simply be forced to stop selling kits.

It would very much be a case of winning a battle, but losing the war. I doubt whether many of our readers would want that kind of a resolution, surely.

Just before leaving Mr Jackson's letter, he does make a very positive suggestion:

I believe it would be a great help to those of us who are not professionals if typical voltages were included in all schematics, so that if something does go wrong, we at least have some information to go on. After all, most television circuit diagrams have them included.

I fully agree. We used to do this, and I'm not sure why the practice seems to have fallen down. There's no doubt that typical voltage figures do help in tracking down any problems, so we'll try to include them again wherever possible.

Thanks for your comments and suggestion, Mr Jackson, and I'm sorry we mislaid the first copy of your letter.

Amplifier earthing

Passing on now to the topic of hifi amplifier and system earthing, which was discussed in the February column and again in May, a long letter turned up shortly after the May issue had "gone to bed". This was from Mr Bruce Hunt, of Heathmont in Victoria.

Mr Hunt believes that none of the discussion published before he wrote his letter tackled what he sees as the real problem:

Quite frankly, the discussions so far evade the real problem, which is the practice of removing mains earth leads from audio equipment to overcome hum loop problems. This dangerous practice is widespread, as no doubt you are well aware, and in my view it is this detail which is the principal matter to address.

I have seen official operations manuals packaged with new (home) audio equipment, actually recommending disconnection of the earth wire from the mains plug if hum is experienced!

"The real problem is disconnecting mains earth leads, to overcome hum loop problems..."

Another classic example is the proliferation of this practice with outdoor and stage PA equipment, which leaves the vocalist or announcer with a live microphone in his/her hand, should one power transformer break down or a wrong connection of the power flex wires are made. One touch to a separately earthed piece of equipment or earthed building service and "Zappo" – one less live body holding a microphone or electrical musical instrument.

Mr Hunt goes on to describe other worrying aspects of this practice, including the use of "piggyback" plugs with earth pins removed as a technique for temporary disconnection of the earth wire. He relates the story of finding one of these devices used in a system in such a way that it effectively removed the safety earth from *all* of the equipment, while still leaving an earth-circuit loop in the system – so the hum remained, and the system was unsafe as well!

Fair enough. I agree that this is an important matter, in terms of electrical safety – although I do see it as rather distinct from the original subject of double insulation and its effect upon audio system performance.

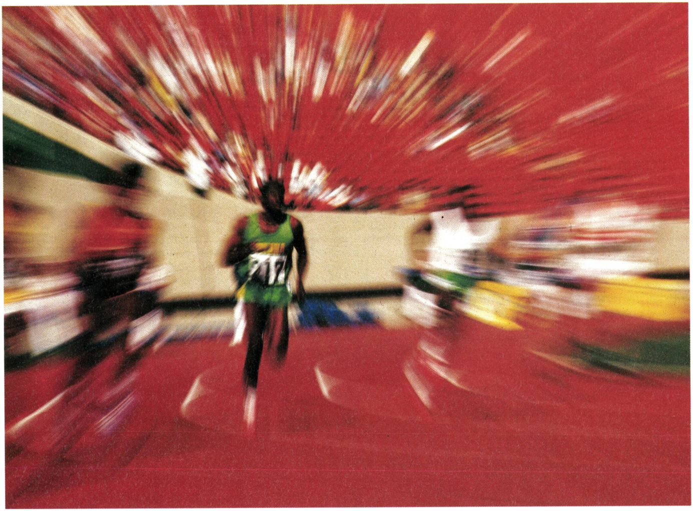
It's true that the practice of disconnecting earth wires is quite common where many pieces of audio gear are connected together and earth loops are created. If you know what you're doing and the pieces of gear are going to be connected together *permanently*, it may be a reasonable approach; in fact it can sometimes be the only way to reduce hum to an acceptable level.

The problem is that where the gear is subsequently separated again, it's all to easy to forget that you've disconnected some of the earth wires, and omit to reconnect them. This can undoubtedly make the equipment concerned a potential death trap.

Mr Hunt's solution to this problem is to suggest that all audio equipment be provided with a three-wire mains cord, but that the earth wire be used solely to earth the frame of the power transformer, which would be isolated from the case and any signal circuitry. This would provide earthing protection for safety, but not pose a problem in terms of potential earth loops and hum.

Essentially what he seems to be suggesting is a kind of cross between the SAA's Class I (earthed) and Class II (double insulated) construction, and I'm not sure how the SAA would view it. Perhaps they would be happy, provided that the power transformer was provided with the appropriate insulation to its secondary winding(s), there was suitably rated insulation between its "safety earthed" frame and the exposed metalwork, and the equipment was *not* provided with the double-squares symbol.

Anyway I think I'd be happy with Mr



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FORUM

Hunt's solution, providing the equipment was also provided with a terminal on the rear somewhere so that the signal common could be connected to a functional earth when required. If this were done as well, I think it would be an admirable way of meeting both safety and functional requirements.

The only likely problem is to persuade the manufacturers over in Japan and Taiwan to adopt such a scheme!

Sundry gripes

Just to end up this month and tie the ribbons on another recent discussion, I've also received yet *another* follow-up letter on the broad subject of nanofarads and other units, as discussed in the March and June columns.

This letter is from Mr Don Fraser, of Mt Gravatt in Queensland, and in it he seems to take me to task regarding almost everything I wrote in the March column. Perhaps I missed something there folks – was April *kick the editor* month?

Perhaps a lot of us are "beyond help"...

It's hard to know where to start with the many points Mr Fraser brings up, because there are so many – and some dealing with what are really only side issues. One thing he quite rightly points out is that I misspelt the word "guttural", in my March preamble regarding English usage. It came out as "gutteral", for which I hasten to apologise. I can't even blame a spelling checker program, because I don't use one!

Another point where he does seem to have me is where I mistakenly used the plural version of a verb with the collective noun *number*: "She pointed out that there were quite a number of areas..." Obviously I should have used *was*, the singular version of the verb. Ah me, I can't take a trick — will writing out 1000 lines of 'I must never use *were* with *a number of* make amends, oh hawk-eyed readers, or will nothing short of a day or two in the stocks satisfy you?

Yet again, Mr Fraser also takes exception to my use of the apostrophe:

> *Before leaving the subject of written English let me record my despair for the apostrophe; your (March) Forum article contained many errors in its use that you are seemingly beyond help!!!!*

Frankly I suspect this one at least would be a matter of opinion rather than fact, because I have certainly tried to follow at least one widely-accepted and *reasonably* consistent set of rules on using the apostrophe. My understanding of its use is that you generally use it to signify either contraction of a word (as in *can't*), or possession/attribution (as in *Don's criticism*). The main exception to this being in the case of *it*, where the apostrophe is used ONLY where you are contracting *it is* to *it's* – and not where you are expressing possession or attribution (as in *its use*).

When I glanced back over the column concerned, it did look as if I had stuck fairly consistently to this common usage. So if it was indeed riddled with errors, as Mr Fraser asserts, I think I'm probably not alone. Perhaps a lot of us are "beyond help", and Mr Fraser may have to continue despairing for all of us...

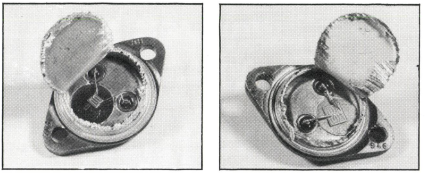
What's that bit in the AA motto, something about "accepting those things that I cannot change"? (Actually I don't think the AA can have invented that most profound motto, it sounds as if it must have been thought up a lot earlier – but let's not have a big debate about it. We're supposed to be discussing matters electronic, after all!)

In fact getting back to electronic units and the nanofarad, probably the main other point raised by Mr Fraser is that multipliers like *kilo* and *pico* have been around for quite a long while, either as such or at least in terms of the multiplier value concerned. For example *kilo* was used for decades as a prefix for *watts* and *cycles per second*, paving the way for its use with ohms and hertz.

Similarly although the *pico* prefix wasn't used until fairly recently, Mr Fraser notes that it was common for people to use the rather clumsy term *micro-microfarad* for some time before that. So the habit of thinking about the value of small capacitors in terms of units of 10^{-12} was not in itself new, when *pico* was introduced.

On the other hand, there wasn't a similar convention of thinking in terms of units of 10^{-9}, before the *nano* prefix was introduced. Hence, says Mr Fraser, the difficulty many people have experienced in coping with the nanofarad. Fair enough, he certainly has a point there, and one that my other correspondents and I did overlook in our original and follow-up discussions. But essentially it's still just another aspect of the fact that we all have difficulty cop-

DUD TRANSISTORS: GRAPHIC EVIDENCE



As noted last month, it would appear that illegally re-labelled TO-3 power transistors have been imported into Australia recently, probably from Hong Kong. The devices are represented as Motorola MJ15003 and MJ15004 types, but appear to be quite different devices of much lower power rating. The above pictures show the chip inside one of the suspect devices (left), compared with the much larger chip inside a genuine Motorola transistor (right). The latter has about 3 times the area of the former, and much heavier bonding wires.

We understand that Motorola is very concerned about this illegal use of its trademarks, but seems to be having difficulty in tracking down and stopping those responsible. In the meantime the company stresses that to ensure obtaining genuine MJ15003/4 devices, customers should procure them via its official Australian distributors VSI Electronics and Soanar Electronics, or their nominated resellers. Customers who have suspect devices in *aluminium* packages with *inked* date codes of "8713" or "8715" should return them to their supplier for a refund or replacement with guaranteed genuine product.

A similar example of fraud occurred about 7 years ago, when devices also labelled MJ15003 and MJ15004, and bearing the identification "TIC" were imported from a source reportedly in Florida. Sold widely, they caused a lot of trouble in many high power amplifiers. Later investigations showed that they were not genuine MJ15003/4 devices, but appeared to be relabelled "junk".

ing with change of any kind – even change for the better.

Incidentally Mr Fraser himself seems to have some difficulty explaining why the *Giga* prefix doesn't seem to have caused any problems, despite its unfamiliar 10^9 connotation:

As far as the prefix "Giga" is concerned, there seems to have been no real difficulty: it's not so long since the concept of 1000 megacycles per second was almost in the realms of science fiction!

Which does seem to conflict with his earlier line of reasoning, doesn't it? By the way I also note that he seems to be following the same rules for using the apostrophe as I do – curiouser and curiouser!

Mind you, he does end up his letter with a strong and unequivocal argument for the use of multiplier symbols to replace decimal points:

You go on to point out that you decided – for drafting purposes – against 4R7, 6N8 instead of 4.7Ω or 6.8nF, on the grounds that the former were neither particularly clear or self-evident. Here once more I take you to task: 6P8 and 4U7 and 8M2 are quite unambiguous, and leave one in no doubt as to the position of the decimal point, which has a distressing habit of disappearing especially in photocopy. Since the advent of computers and calculators with their filthy habit of using leading zeroes, a notation like "068" on a poor photocopy could mean "0.68" or equally well ".068", and this is more noticeable in the case of circuit diagrams from the land of the Rising Sun...

Phew! At least he didn't have a go at me for my spelling of *drafting* — I suppose I should be thankful for small mercies.

Seriously, though, I didn't ever say that using the multiplier symbol to replace the decimal point wasn't unambiguous. I agree that *does* solve the ambiguity problem. What I said (sorry, *wrote*!) was that it was neither particularly *clear*, nor *self-evident*. In other words, that to people coming across this practice for the first time, it's quite mysterious – even cryptic. And I stick by that belief; to me the system may be unambiguous, but it certainly isn't self-evident. You have to have it explained to you.

That's why I decided not to try weaning *EA's* readers over to this system, at least not for the present. Judging by the rather torrid reaction to our adoption of the *nanofarad*, it certainly did seem likely that if I did, they'd organise a lynching party for me!

Anyhow Mr Fraser, thanks for a lively and provocative letter – even if I did feel a bit battered and forlorn when I first read it. I guess it's my head up there at the start of the column, so I shouldn't complain or be surprised if people throw bricks at it. But then an editor's life wasn't meant to be easy, to paraphrase something your namesake once said...

Well, I think that just about wraps up the topics of projects and kit responsibility, double insulation in audio systems and the nanofarad, folks. So next month I plan to move on. There is a different and quite interesting aspect of double insulation which is worth looking at, for example.

One final point: if when you read Forum (or some other part of the magazine) you decide to write in with a comment, could you try to make it reasonably soon after the month concerned? Letters that come in some months later are sometimes quite hard to cope with, because even the follow-up discussion can be over and done with before they arrive.

It can get a bit lonely in the Forum if everyone else has gone home!

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News Highlights

Gough Whitlam to endorse Voca products

Voca communications is to increase its profile in the telecommunications market, with the Honourable E.G. Whitlam endorsing its high tech products in a planned series of national television and newspaper advertisements.

The company's general manager, Paul McNicholl, said that Voca was looking for a new advertising format and wanted Mr Whitlam to become the spearhead of the new campaign.

"We were delighted when Mr Whitlam, who is one of Australia's most respected and popular public figures, agreed to endorse our products."

"One of the very first facsimile machines, which Voca introduced to Australia in 1972, went into Mr Whitlam's office just after he was elected Prime Minister".

Mr McNicholl said that his company had approached Mr Whitlam because voca felt his style and achievements were totally aligned to Voca's objectives in the market place.

Altronics opens Sydney office

Well known WA-based electronics importer, wholesaler, manufacturer and retailer Altronics has opened an office in Sydney. Company sales manager Fred Bloffwitch explained that the reason for the move was to provide customers on the east coast with a higher level of service and support.

Colin Fobister (pictured) has been appointed sales co-ordinator for NSW. The Sydney office is located at the Sydney Executive Centre, 199 Willoughby Road, Crows Nest 2065. Phone (02)

International contract for

A sophisticated new computerised brailler will be given its first public demonstration in Australia at the Technology in Focus exhibition staged in August by the Royal Blind Society in Sydney.

The Mountbatten Brailler, developed in England, will be manufactured and marketed internationally by an Australian firm, Quantum Technology. The multi-million dollar contract to produce the electronic brailler was won against stiff international competition.

The Mountbatten Brailler is the world's first battery-operated portable electronic braille embosser. It allows blind and partially sighted people to produce their own braille more cheaply, easily and faster than the existing mechanical brailler.

IEEE honours Bell Labs for cellular radio

The US Institute of Electrical and Electronics Engineers (IEEE) has awarded its 1988 Corporate Innovation Recognition to AT&T Bell Laboratories, for the development of celluar mobile communications.

The award cites AT&T specifically for pioneering research in the principles of cellular telecommunications technology and leadership in development of the basic cellular system architecture.

Dr. Ian M. Ros, President of Bell Labs since 1979 accepted the award on behalf of AT&T.

News Briefs

- The electronic components division of ***Siemens*** has appointed WA-based firm ***Reserve Electronics*** as an additional distributor of its components in NSW. John Gardner is moving from Perth to Sydney to head up the new operation.
- PCB manufacturer ***Printronics*** has appointed Peter McGuigan as manufacturing manager, Steve Lumsden as production manager and Ann Parnell as technical development manager. The company is also recruiting further staff in readiness for its forthcoming move to a larger plant in Rydalmere.
- ***IRH Components*** has been appointed Australian and New Zealand distributor for the Fairchild range of semiconductors, following Fairchild's acquisition by National Semiconductor.
- Component supplier ***Electronics & Semiconductor Distributors*** (ESD) has moved to new premises at 17 Russell Street, Essendon, 3040. The phone number is (03) 370 5522, fax 370 5572 and telex AA 36833.
- Sydney PCB design bureau ***Electri-Board Designs*** has been restructured, with MD Deric Netting buying out former partner Ilmar Timmerman and taking full control.
- Audio product importer and distributor ***Convoy International*** has been appointed Australian distributor for Harman Kardon high fidelity equipment.
- Brian Barnett has been appointed national sales manager at **Westronics**, Sydney-based contract assembler of PC and telecommunications boards. Mr Barnett is well known for his 17 years with Soanar Electronics, and work at Electronic Industries and Ace Electronics.
- Power electronics firm ***Fastron***, which claims to be the only Australian manufacturer of power semiconductors (under licence from AEG in West Germany), has been restructured since becoming a wholly owned subsidiary of ***BWD Industries***. Four new distributors have been appointed.
- Israeli fibre optics amker Fibronics has appointed ***Integral Fibre Systems*** as its Australian distributor, based in Sydney – phone (02) 451 7033.
- ***Arthrite Australia*** has advised that the solid state message recording unit announced in our May issue has an RRP of $59.00, and will operate from a 9V battery. The firm is located at 16 Stortford Avenue, Ivanhoe West 3079, or phone (03) 49 6606, but the message recorder is available from Radio Parts Group.

electronic brailler

HRH The Prince of Wales examining the Mountbatten Brailler. At right is its developer, Ernest Bate.

The brailler will sell for less than a quarter of the price of existing braille printers, bringing high quality braille production within the reach of individuals.

Quantum Technology, based at West Ryde in Sydney, expects to have a production prototype ready in March, 1989, with full production begining the following June.

The brailler was developed at the Royal National College for the Blind in England, on a grant from the Mountbatten Memorial Trust, chaired by HRH Prince Charles.

"Digital Paper" stores data

A completely new form of optical storage for computer data, announced by Britain's ICI Electronics, can hold 500 times more information than the rigid optical disks and magnetic tapes currently used.

Data transmitted, for instance, by an Earth observation satellite which would fill 2500 conventional 267mm tape spools, could be contained in five reels of the new material, says the company.

Called Digital Paper, it is flexible and robust yet inexpensive to manufacture. Recordings made on it – which are indelible – at a cost of only 0.3 of a penny per megabyte contain the same information as a densely packed note book but are ten times cheaper than magnetic tape storage. They currently have a life rated at 15 years and the company is confident that this will be extended to at least 25 years in the near future.

Digital Paper comprises a specially developed dye polymer coated on to a polyester based substrate.

Its basic recording characteristics are similar to those of rigid optical disks, with data stored by the same type of laser pitting technique. But the new ability to coat the sensitive layer on to a flexible base material makes it much more convenient to use and opens up scope for exceptional versatility with soft disks, tapes, strips or tags able to hold unprecedented volumes of data.

A 730m reel of 13mm tape of the same size as a normal 267mm magnetic tape can store 600 gigabytes or 600,000 megabytes of data. As only the resolution of the laser writing devices available at present prevents data being more closely packed, future developments in laser technology are expected to boost these figures even higher.

In consumer terms, a 600 gigabyte tape would be able to store the entire contents of 1000 compact disks or 300 full-length feature films, says ICI Electronics.

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News Highlights

Defence imager uses 145 Transputers

A portable infra-red imaging system developed for the Australian Department of Defence by SA engineering consultants C.J. Abell uses 145 Inmos Transputers, to provide an impressive 1450 MIPS (million instructions per second) of processing power.

Dubbed *Kuru Muna* (Aboriginal for "Eye in the sky"), the thermal imaging system will be used by the Australian Army to identify military targets by the IR heat emissions produced by personnel and motor vehicles. It can also be used for civilian search and rescue missions, and for detecting bushfires.

NATO IR imagers can only scan 5° and rely on soldiers to detect targets. The Kuru Muna system has a 47° viewing angle, able to detect IR emissions by both night and day at distances well beyond human operators with IR scopes.

Until now the main problem with such wide angle IR imaging systems has been the sheer volume of raw data to be processed. Using the 145-Transputer array the Kuru Muna system produces a high resolution 720 x 720 pixel screen image at a scan rate of 0.7 seconds, with target status monitored by a further Transputer processor.

The Kuru Muna is field portable and can be installed into aircraft, helicopters, Army vehicles and Naval craft.

Alcatel-STC sells power supplies to Taiwan

Alcatel-STC has announced the sale of six model 1CD 120/800 battery charger units for installation into a power station in Taiwan.

The units, manufactured at Alcatel-STC's Liverpool plant, are each rated at 120 volts and 800 amps and will be used to maintain the bank of emergency batteries that power the station's essential services. These include computer systems, instrumentation and the oil pumps for the turbine units.

The sale, valued at $US170,000 was made to the Taiwan Power Company, the owners of the Taichung Fossil Power plant, and represents a first for Alcatel-STC in the region. The company maintains offices in Taiwan and expects that this purchase will be the first of many to a power industry that expects to double in capacity over the next ten years.

Aussie car phones go left hand drive

An initial Canadian order for 1200 cellular car phones has been won by Philips' radio communication manufacturing centre at Clayton, Victoria. Both in-car and transportable versions are included in the order.

Angus Dawes, export manager for Philips radio communications products, explained that as the "AMPS" cellular car phone system adopted by Telecom Australia was developed in North America in the seventies. This means that the Australian designed and manufactured products are entering a mature and very competitive market.

"At this current development of the market, Canadian purchasers know what car phones are about and are quite discriminating." Angus said. "Our products are competing in the middle price range with advanced features derived from the excellent electronic design, so we are expecting to do well."

Governor-General Sir Ninian Stephen examining one of the new Philips cellular phones.

Meanwhile the Philips Australian car phones have also gained type approval from the FCC in the USA. Pilot orders have been delivered to the Philips Telecommunications Equipment company and to car equipment specialists, Amperex.

Printronics biggest hi-tech exporter to China

Printronics claims to have become Australia's largest exporter of technology to China with the recent signing of an agreement for a third joint venture printed circuit board factory. This is the fourth and largest project which Printronics has undertaken in China since signing the first PCB turnkey contract in 1984 and it establishes Printronics as the leading international company operating in China in this field.

The joint venture agreement is with the Tianjin Printed Circuit Board Company, a subsidiary of the City Municipality, and represents a total investment of $US12 million with Printronics holding a 35% equity.

When completed in late 1989, the Tianjin Printed Circuit Board Factory will have the most modern processing equipment capable of producing double sided and multilayer boards to the highest international standards including MILP 55110 and IPC Class 5.

In addition to design, construction, commissioning and staff training, Printronics will be responsible for marketing the boards internationally.

Printronics is also strengthening its position in the Australian market for local and offset export opportunities with a move to larger, newly equipped premises at Rydalmere later this year.

Setec sells power supplies to China

Peter Lloyd, Setec MD

Australian power supply designer and manufacturer Setec has begun production of a power supply for a company in China.

Setec's Managing Director, Peter Lloyd (pictured) said that the initial contract with a microcomputer company near Beijing was worth approximately A$45,000.00, with the potential of further business flowing from the original contract.

Setec power supplies are used in products being marketed in North America, parts of South East Asia, and now China. The company is rapidly establishing an international reputation for quality and reliability. With Setec's design group experienced in dealing with a diversity of international and local standards, and increased production facilities at their Bayswater plant, Setec is looking to the export market as one of its main growth areas.

Former Microbee staff offering assembly service

Keech (Holdings) is a PCB contract assembly firm based at Gosford on the NSW central coast, and consisting of the former production team at Australian computer maker Microbee Systems before that company was acquired by Impact Systems. The company is still making Microbee products, but is now also offering its services to other clients on a contract basis.

The team has considerable experience assembling quality PCBs for computers and computer-related equipment. It also has experience in the mechanical and design aspects of packaging products to be both attractive and cost efficient.

Services available include design, component sourcing, insertion and soldering (wave soldering or manual), cleaning, testing and packaging, with a high level of quality assurance.

Further information is available from Malcolm Keech, Keech (Holdings), 100 Showground Road, North Gosford 2250 or phone (043) 24 1506.

Toshiba develops robot for plant culture

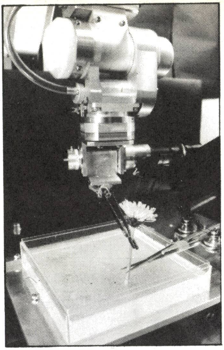
Toshiba Corporation has successfully developed a new prototype robot for automated plant factories of the future where advanced electronics and biotechnology will be used to grow flowering and vegetable plants in clean rooms.

The newly developed robot can be used for nursing young plants in factories, where plants are efficiently mass-produced by dividing each into several portions for tissue culture processes.

The robot, which is a first-stage prototype system, can determine the position of young plants grown on a culture medium, cuts out their stems into proper sizes, and transplants the stems onto another medium.

It is believed that Toshiba's prototype is the first time anywhere that such a comprehensive system has been developed.

The robot finds the position of the plant by utilizing a laser beam as well as a sensor which receives the laser beam reflected from the stem. A multi-joint manipulator robot with a soft gripper akin to tweezers then approaches the plant and grips its stem.



A scissor-like cutter which can change its direction to any angle approaches the plant and cuts the stem slightly below the gripped position to produce a 2 to 3 cm portion. The gripper carries the cut-out stem to the appropriate position on the culture media and transplants it there.

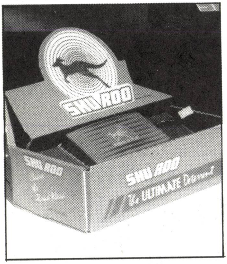
TI chairman retires, TI Australia has record result

Mark Shepherd Jr, long-time head of Texas Instruments in the USA, has retired as the company's chairman. Company president and CEO Jerry Junkins has assumed the additional role of chairman.

During his 40-year long career at TI, Shepherd pioneered the commercial mass production of germanium and silicon transistors, and also headed the company's development of ICs. His term as company CEO has also seen TI grow into the largest international semiconductor company, and its Texas birthplace Dallas grow from a town into a major US city.

TI Australia has also announced a record result for the year ending December 31, 1987. MD Stuart McNair announced that revenue had increased to $45 million, up 15% on the previous year, with profit also up 30.5%.

1988 is the 30th anniversary of the development of the IC by TI engineer Jack Kilby. It is also the 30th anniversary of TI's operations in Australia.



Electronic repeller to save kangaroos

An Australian company has developed an electronic kangaroo repeller designed to prevent the animals being hit by cars and trucks. Dubbed the "Shu-Roo", the unit projects a piercing, variable high frequency sound ahead of the vehicle, claimed to alert and scare away kangaroos at up to 400 metres distance – sufficient to avoid accidents with vehicles travelling at 100kph.

The device is patented and was developed in consultation with leading macropod biologist Dr Tom Kirkpatrick. It does not appear to affect farm stock, dogs or horses.

Greyhound Coaches tested the Shu-Roo quite extensively on one of its coaches in Queensland, and was apparently so impressed that it has now had them fitted to all of its coaches in that state. Another triumph for Aussie technology!

Further information on the Shu-Roo is available from Speed-Safe Radar, 791 Princes Highway, Tempe 2044 or phone (02) 558 4004. It is also available via the company's distributors in each state.

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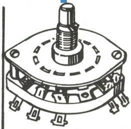

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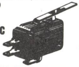

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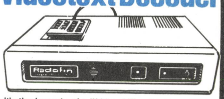

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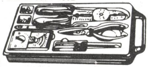

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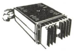

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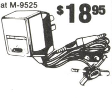

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Frankly Frank

Musings on matters electronic by FRANK LINTON-SIMPKINS

Demolition derby

Over in the land where they invented the Demolition derby, the lads have come up with a new and beautiful way of spending vast sums of money. The guy who starred (second lead actually) in "Bedtime for Bonzo" has approved the building of what is called the Super-Conducting Supercollider, which will cost between 16 and 20 dollars per head for every man, woman and child in America. It may not worry too many adults, but it may wipe out the life-savings of a few small children.

This gadget will require two streams of protons, the opposite of those things from which EA takes its name, to race around an oval track in opposite directions for an 83 kilometre lap. The course is determined by a few magnets – about 10,000 in fact, weighing in at about 60,000 tonnes and with around 20 kilometres of superconducting cable with a little liquid helium (approximately two megalitres) just to make sure nothing gets all hot and bothered and ceases superconducting at the wrong moments.

The streams which are racing around those 83 kilometres or so of track will eventually reach an energy level of around 20 trillion electron volts. Once at this level the two streams will be directed to play chicken, and will impact with fairly spectacular results. It is estimated that the rate of impacts will be roughly 100 million crashes per second. This will not do the protons a great deal of good and will in fact make them rather upset and fractious. They will split up into a whole series of sub-particles, in fact into thousands of bits each. These will be rather hard to detect, but the plan is that each sub-particle will be detected and tracked so that the observers can see what actually happens with free quarks etc.

The planners of the gigantic thing haven't yet found a final home, let alone started on setting one up with magnets etc. When it does go on-line, the energy it produces will be roughly as great as that a small fraction of a second after the "Big Bang" that started it all off. Which brings one to the problem of time.

Not being Doctor Who and having that splendid series of assistants or whatever, I am a little at sea here, but I think that if certain particles called tachyons are formed they will be detected before they are formed. In other cases the detectors will detect things that have happened but other events will have occurred before the detectors can reset.

Frankly I can't see what the Yanks are getting for their $20 each. The detectors will cost about four or five dollars for each man, woman and child in the US and I don't think the kids want them – they'd rather have the fiver.

If you were to set SuperC-SuperC up in Melbourne with the collision area on the old Essendon airport, then the race track would extend out under Port Philip bay in one direction and into the boonies in the other. Can you imagine making sure that the track was properly lined up over 83 kilometres? Liquid helium in pint-sized quantities is also a problem substance, which seems to be aggressively sure that it knows exactly where it is going. In megalitre quantities the problem would be compounded. It is also rather colder than liquid air and the refrigeration unit will probably work out to be larger than the Harbour Bridge.

Personally I can't wait for the Yanks to build the thing. I want to know about quarks, leptons, vector bozons and the speculative Higgs particle. I also want to see how the men who have to fix the thing will get around in the tunnel. I'd expect that no one would want to be in the tunnel when it was operating: it would be cold, your watch would never operate after the magnets had had their wicked ways with it and I'd think that your brain might be operating in Mesmer mode too. (Poor old Mesmer, he was trying it on with Lord Nelson's bird before she was Lady Hamilton and just into Tableaux Vivant and Poses Plastique. Mesmer always considered the animal magnetism approach rather more likely to win out than the "Do you come here often?" ploy.)

Since a full lap of the track is roughly the same distance as Sydney to Katoomba those fix-up boys would have to ride bikes. I would expect push bikes in case the electrics on the bike did any damage, so those guys would be fit.

It will be nice for the boys to know what the first particles were like after the Big Bang. But what good will it do the rest of us? I am certainly happy with the electron-proton situation as it was when I was a child; it explains all that I need to know. And about the big bang I don't much care at all, beyond being sort of glad it happened.

I can't help thinking that with all that money spent elsewhere there might be that final breakthrough to a cancer cure, an AIDS cure, or whatever. It could feed the starving people of the world for a vastly long time, people who neither know nor care for any particles smaller than a slice of bread.

Probably the thing which swings the support of the politicians behind such a project is simply that where ever the thing is put it will yield 4,500 construction jobs, 2,500 jobs while it is operating and $US250 million each year in government spending in the area. In other words the purpose of the thing doesn't matter besides the jobs and spending it will create.

The project has generated other revenue as well. The actual proposal to have the SuperC-SuperC sited in Texas weighed just short of 1000 kilograms. I saw once a proposal in response to a request for a tender in Australia that weighed 300 kilograms. It cost the responding company just one million dollars in 1978. With US costs being much higher and with the intervening time of ten years the cost of the Texas proposal can only be guessed at. The writers of proposals like that don't come cheap and the research and printing costs would be crippling. In the Australian proposal, ten respondent companies would have all spent as much or more on the deal. In the US the SuperC-SuperC was sought by most US states,

continued on page 140

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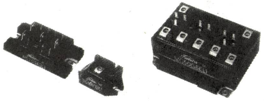

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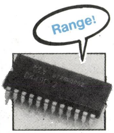

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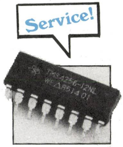

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COLBAR

The Serviceman

The same isn't always, but it can be awfully close!

It pays to have either a good memory or a good filing system, in the servicing game. Sometimes a fault can turn up again in a particular make and model of set, and even if the symptoms aren't exactly the same you can still save a lot of time by calling on past experience.

Back in July '79, I reported on problems with an HMV C221 chassis. At that time the customer complained of a darkish picture, and any attempt to brighten the screen led to objectionable defocussing.

The first diagnosis was a weak picture tube and a new tube was still under guarantee. But this didn't cure the fault, and further investigation showed that the tube heater voltage was low and the tube was consequently being under-run. It was evenutally found that the fault was a small resistor in the negative return to the smoothing capacitor on the heater's DC supply rail. This was a one ohm, 2-watt unit that had increased in value to about 15 ohms.

I was reminded of this story only the other day, when I eventually solved an intermittent problem in the same model. This set lives in a far distant area, which was giving me no end of "aggro" as I negotiated the traffic to and from the scene of its mischief making.

The complaint this time was that there was sound, but no picture. Now this symptom can be be caused by any number of conditions, and if the trouble is intermittent, it can waste hours of your time in fruitless searches of various parts of the set.

By the time I reached the set on the first occasion, it had "come good" and no amount of thumping and banging could cause the fault to reappear. This was the pattern on the next couple of visits, so I decided to take it back to the workshop. At least, I would save travelling time whenever the fault appeared.

Once back at the workshop, the fault showed up often enough for me to get some idea of the type of trouble, which seemed to be intermittent electrical rather than intermittent mechanical. It's hard to describe the difference between the two kinds of fault; it's one of those things that an experienced technician feels in his bones, without knowing quite why.

In this case I felt that the cause was an intermittent open circuit or high resistance, something like a dry joint inside a resistor or capacitor. Unfortunately, it was not responsive to the usual screwdriver test, so I could not isolate it to any particular part of the chassis. The fault chose its own time to come and go, and none of the conventional tests would alter its pattern.

The odd thing about the fault was that when it did show up, I could find, nothing wrong with any of the voltages usually involved in loss of picture. All the picture tube voltages were spot on, and the rail voltages in the chroma and video circuits were all present and correct.

An oscilloscope check at the tube cathodes showed that near normal video was being supplied to the tube, and together with normal voltages on the tube elements should have presented a perfect picture. So for several days I went over and over the chassis, in sickness and in health, and couldn't find a thing wrong with it.

After a week or so in my workshop the fault occurred less frequently, and after about 10 days it disappeared altogether. Then for several more days the set was perfect, so I packed it up and took it back to the owner.

It took a week for the fault to recur, and about a month later it became permanent. The picture disappeared and refused to come back at all.

I might never have found what was wrong with the HMV if a Philips set had not come in with a similar complaint – no picture. In fact it was more similar than I suspected at first, because all picture tube base voltages were normal. Then I noticed that one of the two leads to the picture tube heater had come off its plug on the line output transformer. Replacing this brought up a perfect picture – and suddenly the penny dropped.

As soon as I could get back to the HMV, I fired it up and waited for signs of life in the neck of the tube. I knew that I was on the right track, because there was no trace of a glow from the picture tube heater. The cathodes were as dark as if the set was turned off.

A check at the heater lead terminals on the power supply showed only two volts on the heater. No wonder the tube was not working. I must admit that I first thought of an intermittent heater in the tube, but the low voltage gave a much more palatable reason for the fault, so I set about finding a cause.

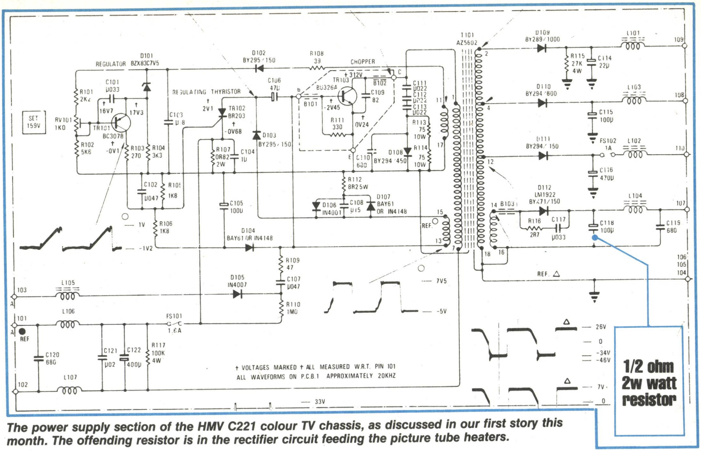
From the mists of memory I recalled the earlier set, and the reason for that breakdown. I wondered if this might be a similar fault, so I went straight to the resistor mounted beside the heater rail filter cap.

Checking back in my original story, I had reported a one ohm two watt resistor which had gone up to fifteen ohms. In this set it was a half ohm two watt. Only it wasn't a half ohm anymore, it was about 38 ohms. It must have been going high and low intermittently, ever since the fault first showed up.

One of the difficulties of doing house calls is maintaining a full range of spares in the van. If I had to carry everything I might need, I'd take the whole workshop with me – and even then there'd be something I didn't have!

On this occasion I wanted a half ohm two watt resistor, and I had nothing like it on board. The nearest I could get to it were some one ohm quarter watts and I decided that they would have to do for a temporary fix. I put two in parallel to make a half ohm half watt and fitted them to the power supply.

At switch-on the picture came up beautifully, and confirmed that this was indeed the cause of the trouble. The only problem was how long the patch would last.



The power supply section of the HMV C221 colour TV chassis, as discussed in our first story this month. The offending resistor is in the rectifier circuit feeding the picture tube heaters.

I've now got the correct part in the van and will call in to complete the repair the next time I am in the district. Although the customer has had the situation explained to him, I hope the patch lasts until I get back because I don't like my customers to be inconvenienced in this way. He has paid me to do a job and it's only half done until it's completed.

So, as I started off this story by saying, the same fault isn't always exactly the same – but it does pay to keep a mental list of these old Serviceman stories. Even if you're me, if you know what I mean!

The silent Sanyo

My second story this month concerns a repair job where it took a further frustrating two hours to tidy up things, after the nominal "repair" itself had taken only twenty minutes to complete. There's no quicker way to lose money than to spend time that you can't charge for on a job that's already "finished".

The story concerns a Sanyo television, a model CTP7602 lowboy. The set arrived in a NOGO condition. It had been out of action for some weeks, and the owner couldn't remember anything about the breakdown. So I was very much on my own.

However, by all initial appearances it seemed to be a very easy job. The main B+ fuse was open, because a diode in the PC board was shorted. Then I found the 120V rail was up around the 150V level, because one of the two series regulator transistors was shorted.

In little more time than it takes to tell, the set was going like a charm. I fitted the cabinet back, then lifted the set down from the bench and pushed it into a corner for a soak test.

For an hour or so the set worked perfectly, but some time later I realised that the sound had disappeared. I tried the other channels, in case it was a programme fault, but they were just as silent as the one that had been showing.

This was a bitter blow, because the job was finished, costed, and ready to go home. Fortunately, I hadn't called the customer, so I had time available to try to sort out the problem without embarrassment.

I cleared a space on the bench and hoisted the set back up. At this point I noticed that the sound had not failed completely. There was a very faint, distorted sound which appeared to match the picture on the screen and seemed to be responsive to the volume control.

This last observation cleared the sound IF, sound detector and preamp. It seemed likely that the fault lay in the output stage, which in this set consists of just one power transistor. It shouldn't be hard to solve – or so I imagined.

My first test was to turn the power off and use the low ohms range on my multimeter to apply a voltage between collector and emitter of the output transistor. This should have put a pulse through the output transformer and made the speaker crackle. Except in this case there was no crackle.

I moved the probes to the primary terminals of the transformer and here I got a healthy crackle. So the transformer and speaker were OK. And the transistor was not shorted, so it seemed that it had to be a break in the lead to the transformer.

But the lead checked out perfectly. So what was going on? It seemed that the transistor must be faulty after all, in some way not obvious to a casual metering. So I took it out of the chassis for a more exacting examination. I could find nothing wrong with it, but I changed it anyway. It was quite a letdown when the new transistor showed no more go than the old one.

But a strange fact emerged at this point. Even while the output transistor was disconnected and was in fact lying on the bench, the set was still playing the very weak sound mentioned earlier. This didn't make any sense, until I realised that this audio output stage is unusual: it has an extra winding on the output transformer. This is a feedback circuit, connected to the base of the output transistor. In this case the speaker was being driven by the signal on the transistor base, through the feedback winding.

With the new transistor fitted, I tried some voltage checks, in the hope that this would point the right way. And so it did, although not immediately.

The collector of the output transistor is shown at 110V, dropped from a 120V rail in the output transformer. The base is fed with 5V output from the preamp section of the audio detector chip. The emitter should read 4.5V, developed across a split emitter resistance, R416 and R417.

In my set the B+ rail was at 120V, and the collector was at 110V, as it should be. From this, I assumed that the transistor was turned on, and drawing its proper current. The base was reading 5 volts, as it should, and a signal tracer showed that there was healthy, undistorted audio on the terminal.

The situation changed dramatically when I came to measure the emitter voltage. It was not at 4.5V, as the previous measurements might have predicted, but at 18V.

At this point I did a double take, as they say in the movies. How can a series circuit have two different current levels at the same time?

At the collector, the current was dropping 10 volts, as it should do if all was working normally. Yet at the emitter, a similar current (Ic + Ib) should only develop 4.5V, not the 18 volts I was measuring.

Clearly, there was something wrong in the emitter circuit that required further investigation. The two resistors concerned are located at the rear lefthand corner of the main circuit board. They are not easy to get at from the top, but can be reached if the chassis is swung out on its top hinges.

Unfortunately, the designer of the set didn't allow an inch more lead than was necessary to permit the chassis to swing out to its locking position. I had great difficulty in getting it right up. I even had to remove the power lead clamp before I could get at the copper side of the board, to begin measuring.

I measured R416 at 33 ohms, as shown in the schematic. Then R417 weighed in at 56 ohms, spot on to the value shown on the diagram. I removed C409, in case this was influencing the reading, but no – the emitter to ground was exactly 89 ohms. Or was it?

For some unknown reason, I then measured from the earth track on the PCB to one of its holding screws. In retrospect, it was a silly measurement to take. Like ohming a short length of wire. But it was most revealing, because what should have been zero ohms was in fact something more than 200, above the low ohms range on my digimeter.

I had checked the chassis frame as an earth when I was working on the series regulators early on. But in the audio emitter circuit I had been measuring to PCB earth, not to chassis earth. In fact, the ground tracks on the PCB were virtually floating at some 14 volts above the true earth.

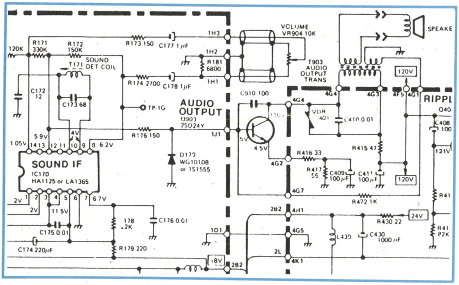
There must have been a return to ground somewhere in the set, but at a moderately high resistance. I didn't think to check this on a higher range – it might have been revealing – but it was certainly high enough to cut off the audio output.

An examination of the overlay in the manual shows various parts of the circuitry returned to ground through this particular part of the pattern. These include a bypass capacitor on the 200 volt rail, a resistor and diode involved with vertical blanking, part of a voltage divider and its decoupling capacitor in the horizontal oscillator, two more electros in the high voltage regulator area, and pin three of the convergence plug.

It beats me as to how all of this circuitry could be effectively disconnected from ground without showing quite noticeable symptoms. I would have expected at least horizontal instability, and probably vertical retrace lines as well. In fact, the only obvious symptom was the lack of sound, so I presume that whatever the resistance to ground had been, it was high only in relation to the audio circuits.

The earth return for the rear half of the main circuit board pattern is by contact with the main frame through small patches of solder coated copper, each surrounding one of the three screws holding the board to the frame. In many other sets this form of contact would have been backed up with a soldered link, and I can't think why it wasn't done in this case.

continued on page 140



The audio section of the Sanyo CTP7602, as discussed in this month's second servicing story.

TETIA Fault of the Month

Sanyo CTP3618 (8OP chassis)

Symptom: Q451 (2SD869) line output transistor short circuited. Main B+ rail up from 110V to 220V and supply will not regulate.

Cure: C314 (47uF 25V electro) low value. This cap provides the link between the error detector and the chopper circuit. When it loses capacitance the chopper is allowed to stay on for too long, hence the high output.

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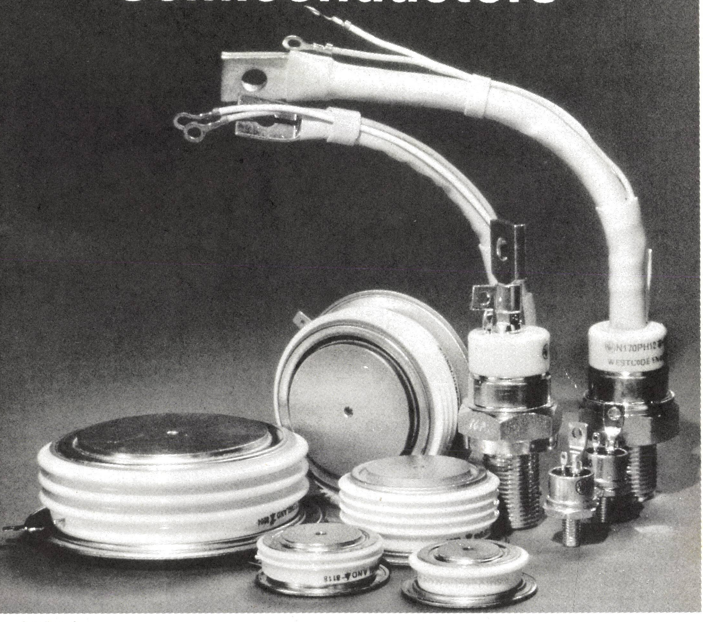

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Silicon Valley NEWSLETTER . . .

Tandy announces erasable CD, PS/2 clone

Tandy Corporation, long regarded as a manufacturer of hobby and educational computers, has made a dramatic move to shatter that image and move to the forefront of both technology and the small business/corporate segment of the personal computer market.

In a major announcement, Tandy revealed that it has developed a revolutionary new technology that for the first time will allow consumers to both play back and record music and data on compact disks. This is a technology that many major consumer electronics firms around the world have been trying to perfect.

Tandy said the technology, which it will license to consumer electronics manufacturers, was developed at its laboratory in Silicon Valley. But it will probably be at least 18-24 months before the first CD playback/recorder will reach the market. The demand for such a product could be enormous, particularly if consumers can use it to produce their own CD recordings.

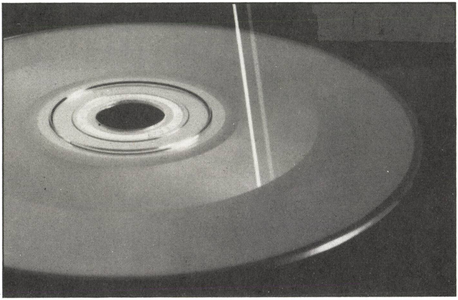
Not surprisingly, the Tandy announcement drew an immediate critical response from the music recording industry, which feels threatened by all of the new forms of high quality digital recording technology such as DAT (digital audio tape) and now the prospect of erasable/recordable CDs.

"We are always concerned about technologies that threaten to allow consumers to infringe on copyrights", said Trish Helmers, a recording industry spokesperson.

Tandy said its technology uses a laser beam to record tiny pits on the disk. The disks are compatible with all existing audio CD and CD-ROM players.

Industry analysts said it was too early to tell whether Tandy will have won the race to bring erasable CDs to market, as the company must still prove it is capable of producing the disks and player/recorders in volume.

Tandy has also announced a long-awaited clone for the IBM PS/2 model 80 personal computer, three days after a similar announcement by Dell Computer. It may well be that the firm will be first to actually ship product, however, as its 5000 MC system is expected to be in stores by the end of July.



Tandy's new Thor-CD compact disc technology allows discs to be erased and recorded at will, while retaining full replay compatibility with existing CD audio and CD-ROM players. Thor-CD recorders are expected in about 18 months, at a cost of around $500.

The new model is built around an Intel 80386 chip set, with critical controller chips made by Adaptec in Milpitas. It will come with 2 megabytes of RAM and a 40Mb hard disk, and carry a starting price tag of $US6499 – about $US500 cheaper than IBM's model 80 with only 1Mb of RAM.

Motorola announces new RISC chip

As expected, Motorola has made its entry into the RISC microprocessor market with the announcement of its 88000 series high-performance processors, which the company claims feature up to five times the performance of competing RISC chips from MIPS, Sun Microsystems, Intel and Advanced Micro Devices.

"Our 68000 series reached up and pulled down prices in the industry," said Motorola vice president John Mitchell. The popular microprocessors allowed manufacturers to put the power of a minicomputer into a workstation or personal computer and reduce the system cost by a factor of five. The 88000 family, he said, will "provide a second such revolution and bring the power of high-performance supercomputers down to the microcomputer level."

The 88000 consists of a set of three chips, as opposed to competing chips which come in sets of up to 50 different pieces of silicon. "The more performance you put into a computer system, the less the computer gets in the way of users," said Jack Browne, director of marketing for Motorola's high-performance microprocessors.

DRAM crisis could ease next year

The critical shortage in DRAM chips may ease in the second quarter of 1989. Then again, it may not, according to Dataquest, which hooked up dozens of trade journalists around the US during a "press conference". The San Jose market research firm also said it expects US chips sales to grow 24.3% in 1988, to $US13.8 billion.

The shortage of DRAM chips, and

the impact on various other high-tech markets, dominated the discussion of the conference.

According to Dataquest president Manny Fernandez, DRAM prices have skyrocketed to $US3.50 for 256K chips and $US19 for one-megabit chips. While most of the large system manufacturers have been protected from severe shortages because of their long-term supply contracts with the DRAM suppliers, many smaller firms are hurt very badly, Fernandez said. In some cases, companies that need just a few 1-megabit DRAMs are facing prices of up to $US80 per chip on the spot market!

Because they are unable to obtain enough DRAM chips to meet the demand for their systems, some manufacturers have started to ship products to customers without the necessary memory chips. "DRAM shortages have caused some technical workstation manufacturers to start offering a "ZERO DRAM" option in their products. This option is useful for customers which can obtain their own supplies of memory, or to people who need to purchase products now because of budget demands. They must buy now or the money goes away."

One indication of how far the industry lacks behind in output capacity, according to Fernandez, is that it would take a staggering $1.8 billion in new plants and equipment to bring the industry's DRAM output capacity up to the level required to meet today's demand. Because new plants are not coming on line fast enough, the shortage will probably last well into 1989.

But Fernanadez said the DRAM crisis may be prolonged into the early 1990s if OS/2 becomes the new standard in personal computer operating systems. OS/2 requires a minimum of 2 megabytes of DRAM, double the amount used in most of today's personal computers.

AMD chief surges ahead

Times have been difficult for Jerry Sanders and his AMD chip business. But the good times appear to have returned to AMD, judging from the company's latest results, and have Jerry's outlandish quotations.

At a dinner meeting of the Semiconductor Equipment & Materials Institute (SEMI) recently, Sanders made a pitch for cooperation between the chip industry and the equipment manufacturers. And Sanders made no bones about the need to get things going fast:

"The equipment and materials industry is going to have to get into bed with us. We are going to have to make some babies together. But we may not have the luxury of taking time to fall in love first."

If anyone stands to benefit a good deal from AMD's apparent recovery, it will probably be the local Rolls Royce dealership. After almost three years of recession, Sanders may have worked up quite an appetite for some additions to his collection. And he has the money to purchase them.

AMD disclosed that Sanders received $US1.05 million in bonuses during 1987, a year during which AMD lost $48 million. The '87 bonus compares to $477,000 in extras in 1986.

The increase apparently included a one-time bonus of $500,000 which Sanders received for signing a contract to continue as head of AMD for three more years. That package also included a base salary of $600,000 a year which, depending on AMD's performance, can be increased, but not reduced during the length of the contract.

Computerland founder claims Wordstar "stolen"

William Millard has fired off a major legal salvo at his adversaries, as the founder of the ComputerLand computer retail store chain filed lawsuits against MicroPro International and Marriner & Co.

The lawsuit against MicroPro alleges that the San Rafael company stole the popular WordStar wordprocessing program 10 years ago, from a company known as Imsai Manufacturing, a bankrupt firm that was Millard's original computer company.

The lawsuit against MicroPro and two of its early officials drew a cynical response from company president Leon Williams. "It is absolutely without merit. I am about as concerned about this as about an iceberg hitting the Golden Gate Bridge."

In the suit against Marriner, Millard charges that the company violated its fudiciary responsibilities as a lender by selling interest in Marriner's convertible note to a company headed by an arch enemy of Millard.

Back in 1976, when Millard was struggling to raise money for his new ComputerLand venture, Marriner loaned him $250,000. The note stipulated that the lender could enforce a clause calling for the loan to be paid back in the form of a 20% stake in ComputerLand. Marriner sold the note to the MicroVest group of investors, which eventually won a drawn-out court battle against Millard over the 20% ownership.

The suit against MicroPro names Seymour Rubenstein, MicroPro's founder and former chairman and John Barnaby, a former MicroPro programmer. Both worked at Imsai before they formed MicroPro in 1978. In the lawsuit, Millard says the two took with them most of the programming that had been completed by then for "NED", an early version of what later became Wordstar.

Bug in crucial military computer

A $US800-million computer system that controls most of the US and NATO military satellite communications networks has been found to contain glitches that are inhibiting the performance and reliability of the system's sensitive satellite operations.

According to memos from a Navy official the system, located at the "Blue Cube" in Sunnyvale, cannot handle as much data as the military had expected. At times, the system also has stalled and shown itself vulnerable to errors that have caused some ultra-secret and potentially critical messages to be garbled or lost. In some cases interruptions have lasted up to several seconds, resulting in the loss of large blocks of data – which are transmitted at tremendous speeds.

The system, including its sophisticated software and much of its hardware, was built by IBM's Federal Systems Divsion.

At the Blue Cube, the system controls three separate constellations of satellite systems. One belongs to NATO and handles diplomatic and miliatry communications between the US and its NATO allies. Another is the Defense Satellite Communications System, which relays messages between embassies, intelligence agencies, Army field commanders, and the White House. A third constellation is the Fleet Satellite Communications System which links the Navy's submarines, surface ships, airplanes, and shore bases.

According to the Navy's memos, the system may never meet the operational requirements it was designed for.

The problem with the Blue Cube is expected to significantly slow down the planned transfer of many of the facility's operations to a new command post being built at the Falcon Air Force Station in Colorado.

Recording Australia's Oral History – 3:

Other gear you'll need

Continuing his discussion of the equipment needed for a home recording studio, the author this month looks at microphones, mixers, grams and minor accessories. These items might not be strictly necessary for straight oral history recordings, but their availability and use give your work a professional touch – as well as making the job easier.

by JIM LAWLER, MTETIA

The microphones used by professional radio people cost many hundreds or even thousands of dollars. For the most part they combine excellent performance with rugged construction. On the other hand the microphone that came with your cassette deck was worth about seventy-five cents, and generally gives that level of performance.

In between these extremes there is a wealth of useful equipment that will give you good results at a reasonable price.

No one microphone will give good results in all circumstances, but it is possible to select a unit that is very good for speech, another that is good for music and so on.

The microphones that I use cost from forty to one hundred dollars each and among them are some very fine units indeed. They were selected firstly for recording music, but those that failed the test included a few that are very good for speech.

In the medium price range there are really only two types of microphone. These are the dynamic and electret mikes. The dynamic type is a magnetic unit and requires no external power. It can be made with a very good frequency response but its construction limits the low volume sensitivity – the ability to pick up very soft sounds.

The electret microphone is a development of the "condenser" mike, considered to be about the ultimate microphone for professional use. The condenser mike needs a special power supply, but the electret needs only a single torch battery to power its tiny built-in amplifier. This amplifier gives the electret superb sensitivity and makes it ideal for recording the proverbial pin falling.

In general terms a good electret is cheaper than a good dynamic microphone and is probably more readily available. However, I prefer the dynamic mike for speech and portable operation, even though it is less robust than the electret. For fixed studio work, and particularly for music, I find the electret is to be preferred.

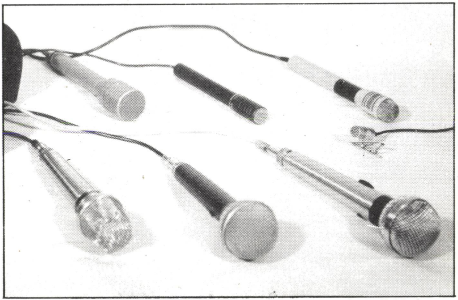
When you come to buy a microphone, try to get a couple from your dealer on "appro" for the weekend. Try them out by making a variety of test recordings of speech and music, from varying distances and at different volume levels. Select a mike that shows reasonable sensitivity, without excessive sibilance or boominess. For most of our work, a good speech mike is what we are looking for so don't worry if it fails the music test.

Some electronics/hobby stores carry microphones, but be careful that these are not for CB or amateur radio use. Communications mikes are not at all suitable for the present exercise.

And finally, don't worry too much about the words "cardioid" and "omnidirectional" in the microphone specifications. These refer to the pickup pattern of the microphone. The main point to remember is that cardioid mike can discriminate against noise coming from any direction other than directly in front. This is useful when interviewing in noisy locations. We will deal with this in more detail in a later article.

Mixers

As mentioned last month, some recorders have multiple inputs, with or without individual level controls. Sorting out which control operates on which input can be a real pain, particularly if your talent is standing by, fingers drumming on the table. It's much better to go semi-professional and have a multi-



A wide range of medium priced, good quality microphones is available for amateur use. This selection includes both electret types (rear row) and dynamic types (front row).

input mixer with the ins and outs permanently connected, clearly labelled and ready to hand.

Like microphones, mixers come in many models, from a few dollars to several thousand dollars. For our applications, anything under $200-$300 is a bit too rudimentary. For about 300 dollars you will get something like a "six in, two out" mixer with mike and line level inputs, bass and treble equalisation, and a left-right "pan pot" in each channel.

This last item is a control used to direct the input signal to one or other of the two stereo channels. In our case it is centred and thus directs the same signal to each channel and creates, in effect, a monophonic recording.

A mixer of this type, at about this price, is supplied by the Tandy organisation under the "Realistic" brand. Its catalog number is 32-1210. I have had one of these for several years and it has done a sterling job in recording and public address applications.

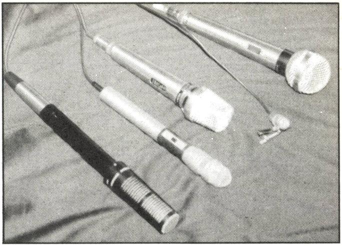
Using this mixer, I can have six low level inputs, either microphone or phono, and six line level inputs, from tape or amplifier, connected to the mixer at all times. Effectively, I have twelve inputs connected to a six channel mixer. Although the back of this mixer is a mess, with wires like jungle vines going everywhere, I can still instantly select any input with the appropriate switch and volume control. This ease of selection saves hours of fiddling with plugs and cables when I come to assemble the final recording.

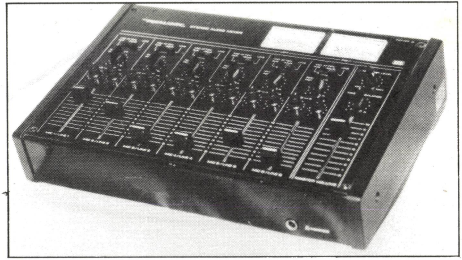
When you select a mixer, try to get one with four or six identical inputs. Some mixers are delivered with non-identical inputs, dedicated to phono, mike or line. These instruments are not very versatile and you will often find that you want an extra line input, rather than a phono or mike input. Only a mixer with identical inputs and suitable equalisation has the versatility for our work.

The word equalisation sounds daunting but it is really only a stylish term for "tone control". When the bass and treble equaliser controls are centered, the mixer's frequency response is flat. Adjusting either control will raise or lower the response at that end of the spectrum.

For example, a magnetic phono cartridge has a falling bass response and if it is played through a mixer with flat response it will sound very tinny and decidedly low-fi. Adjusting the bass equaliser control to the plus 6db/octave position should completely change the sound to the rich, full bodied tone that we expect from modern records.

A further selection of suitable microphones. The two at the bottom are electret types, as is the miniature tie-clip unit, while the other two are omnidirectional dynamic units.





The "Realistic" model 32-1210 audio mixer, a moderately priced unit offering 6 channels, each with pan pot and equalisation.

The equaliser controls should be able to compensate for any deficiencies in the frequency response curves of the system, from microphone to loudspeaker. If you know the response deficiencies you can make deliberate compensation, but it is quite in order to adjust the response by ear – if it sounds right, it is right.

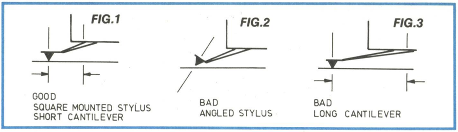
Another point to look for in a mixer, and all the other equipment for that matter, is plug compatibility. It is surprising just how many different plugs and sockets there are in use. Domestic equipment can be fitted with any of three sizes of phono plugs, RCA plugs, DIN plugs, or any of several other non-standard plug and socket combinations that the manufacturer may favour. The professionals have solved the problem by standardising on the XLR plug, a heavy, robust and very expensive system.

Your equipment should be selected with 6.5mm phono plugs for microphone and headphone sockets, and RCA plugs and sockets for all other functions. The European standard DIN plug is fairly common on consumer equipment, but it is small and delicate, and not rugged enough for equipment that is to be frequently moved. Besides, phono and RCA plugs are common, cheap and easy to repair or replace.

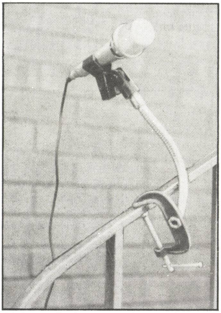
Useful accessories

Other useful bits you might gather as money or opportunity permits are microphone stands, windshields, a cassette head demagnetiser, and a supply of blank cassette labels.

You can never have too many mike stands. You need tall ones for standup comics, and stands with horizontal booms for musicians. Short desk stands are useful when you and your talent are seated at a table. A carpenter's G-clamp with a flexible gooseneck mike holder is a valuable asset. It can turn a chair or a picket fence into an im-



Figs.1-3: Good and bad pickup stylus arrangements.



A cheap G-clamp can be used to make a very handy mic stand!

promptu mike stand and eliminate handling noise in any situation.

You will need windshields for each of your microphones. Some mikes have built in shields, but these are rarely very successful. The "Foam Dome" detachable types are far better. These come in a number of sizes and several densities.

A head demagnetiser is a service tool that should be used at regular intervals, even on your domestic stereo. A magnetised head leads to increased background noise and poor frequency response. The most convenient demagnetiser is built into a standard cassette case. It is powered by an internal battery and needs only to be inserted in the cassette holder, the play button pressed, and the job is done – better quality and lower noise.

Finally, the blank cassette labels. Have you noticed lately how the label provided by the cassette manufacturer is giving you less and less space to write in your details? Blank labels carry no makers name, no blurb about how good the tapes are, just lots of room to write in your details.

Grams

NOTE WELL: In this section we talk about copying discs. In most cases this is an illegal operation and can result in prosecution for Copyright violation. Some special discs are available for this purpose, and in some cases arrangements can be made with the copyright owner to allow dubbing of ordinary discs. The following section is for information only, and responsibility for any misuse of the information lies solely with the reader.

If you have ever played a gramophone record, you might have noticed that the run-in grooves vary in length from record to record. When we are dubbing music on to our programme tapes, we cannot sit waiting for the music to start – the disc must be "cued" so that the music will start at the precise moment that the talking stops. This involves handling the disc and turntable in a way that is not recommended for casual use. It's OK if you know what you are doing, but be careful!

There are two ways of cueing a disc. One is to position the stylus at the start of the track, then backspin the disc half a revolution and leave the stylus sitting on the disc in this position. The other method is to cue the disc to just before the start of the track, then hold it still while the turntable continues to rotate under the disc.

These procedures require for (1) that the turntable comes up to full speed in half a revolution, and for (2) that the motor has enough torque to keep the turntable rotating against the friction of the stationary disc. There is no way that our domestic turntables will meet these requirements, but we need to select the one that comes closest to them.

With most home record players, procedure (1) will be the only one available to us. I have yet to find any machine powerful enough for option (2). So, what we are looking for is a turntable that gets up to speed as quickly as possible.

The turntable must necessarily be either belt or direct drive. The old and once common "idler" drive is too prone to noise and rumble for our purposes. A heavy turntable might resist speed variations and noise transmitted through the base, but it will be slow to start up. So a good quality lightweight turntable will be more adaptable to our needs.

Most domestic record players are mounted on soft springs, with transit screws to lock the deck for transport. Spring mounting is great if the unit is to be used at a party, in a room full of dancers but for our use the last thing we want is a turntable that bounces up and down while we are trying to cue a disc. So make sure that you can still play a disc with the deck locked down, i.e. with the transit screws right up.

The cartridge fitted to the pickup arm should be a robust one, of reasonably high quality. The main requirement is that the stylus sits at right angles to the disc, at the end of a short, rigid cantilever (See Fig.1). If the stylus leans out of the groove (Fig.2), it will likely dig into the disc when you try to backspin. If this happens you will certainly bend the cantilever and ruin the stylus. Likewise, a long cantilever (Fig.3) is less stiff than a short one, and is thus easier to bend accidentally.

You will need to use a magnifying glass to see this, but it is important. Put a disc on the turntable, and the stylus in an outside groove. Spin the turntable slowly backwards and watch the stylus. If there is the slightest tendency for the stylus to jitter or bounce along the groove – stop! That cartridge/stylus combination is unsuitable for cueing. What we are looking for is a stylus that moves easily in either direction.

There is no point in selecting an expensive cartridge for the work we are doing. Our stylus will lead a rough life and it is better to replace a less expensive item more frequently.

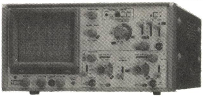
Any accessories associated with the record player, such as disc brushes or dust covers should be fully removable. They are acceptable, even useful for playing records at home, but they'll become infernal nuisances when you are trying to cue a disc in a hurry.

Finally, ensure that the turntable on/off switch works gently and is not likely to jolt the stylus out of the groove it is cued in.

Next month I will begin summing up, with some suggestions about where to look for subjects for our oral history work.

Call Geoff for all your instrument needs

20MHz GOS-522 popular low cost scope

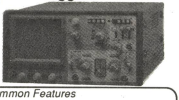


Features

- Sensitivity : 5mV/div to 5V/div
- Bandwidth : dc to 20MHz.
- Timebase : 20nS/div to 0.5s/div

$863.10 ex tax
$1006.95 inc tax

20MHz GOS-523 with delay and alternate trigger mode



Features

- Sensitivity : 5mV/div to 5V/div
- Bandwidth : dc to 20MHz
- Timebase A : 20ns/div to 0.5s/div (Main)
- Timebase B : 20ns/div to 0.5ms/div (Delayed)

$1037.60 ex tax
$1210.55 inc tax

40MHz GOS-543 top of the line

Features

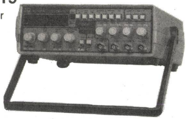
- Sensitivity : 5mV/div to 5V/div
- Bandwidth : dc to 40MHz
- Timebase A : 20ns/div to 0.5s/div (Main)
- Timebase B : 20ns/div to 0.5ms/div (Delayed)

$1285.10 ex tax
$1499.30 inc tax

Common Features

- Max sensitivity : 1mV/div
- Modes : Ch1, Ch2, Dual, Ch1±Ch2, X-Y
- Sweep : Auto, Normal, Single

Function Generator GFG-8019



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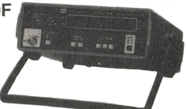
- >20Vp-p open Circuit output, 10Vp-p into 50Ω
- Variable duty cycle and dc offset
- VCF gives 1000:1 frequency ratio for 0-10V input **$554.95** ex tax **$643.80** inc tax

Frequency Counter GFC 8010F



- Frequency Range from 1Hz to 120MHz
- Sensitivity <20mV, 10 to 100MHz, <30mV 100MHz to 120MHz
- 8 digit display
- 0.1s, 1s and 10s gate times

$307.85 ex tax **$359.20** inc tax

Just In! EPROM Eraser Model LER-121

Capacity : 9x 24pin or 6x 28pin or 6x 40pin
UV Source : 2537°A, 5000µW/cm²
Tube Life : 3000hours approx
Size : 260mm x 86mm x 70mm
$95.35 ex tax **$110.60** inc tax

23-Pin 'D' Connectors

No it's not a misprint - there are now 23-pin connectors on some of the PC's. Geoff of course has 'em! Plugs, sockets and backshell. All **$3.50 each**

Fans We have a further small quantity of those quality ITT tangential fans. Made in Germany. High throughput at low pressure across the whole width of the impellor. Noise level is less than a whisper! Self-lubricating sintered bronze sleeve bearings. 240V ac operation. Delivers 34litres/second. **$49.50** (P&P $10 due to their bulk!)

IBM Printer Cables

1.75m and with quality connectors on both ends. You couldn't make them for this price! **$14.95**

Reliable Bench Power Supplies

Features

- Short Circuit Protected
- Auto Constant Voltage
- Constant Current Indication
- 0.01% +3mV (typ) Line & Load Regulation
- High Quality 4mm Binding Posts
- 0.5mV or 1mVrms (typ) Ripple & Noise
- Class 2.5 Analog Panel Meters

GPR3030
0-30V, 0-3A Single Output

- V & A analog meters
- Fine & Coarse Voltage Control
- Hi and Lo Current Ranges

$237.60 ex tax
$277.20 inc tax

GPD3030 2x0-30V, 0-3A Dual Output

- Series, Parallel, Independent or Dual Tracking
- Four Analog Meters (V & A for both channels)

$563.90 ex tax
$657.90 inc tax

GPQ3030 2x0-30V, 0-3A Dual Output plus Fixed 5V

- As above but with additional dual fixed +5V, 1A and 3A supplies
- Fixed outputs have LED overload indication

$636.77 ex tax
$742.90 inc tax

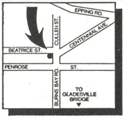
GPQ3030D Dual Supply with Digital Meters

- As above but with two 3 1/2digit panel meters with 0.5%+2 digit accuracy

$696.95 ex tax
$813.12 inc tax

GEOFF WOOD ELECTRONICS

GEOFF WOOD ELECTRONICS PTY LTD
229 Burns Bay Road, (Corner Beatrice St.) INC IN NSW
Lane Cove West, N.S.W. P.O. Box 671, Lane Cove N.S.W. 2066
Telephone: (02) 427 1676, Fax: (02) 428 5198.
8.30am to 5.00pm Monday to Friday, 8.30am to 12 noon Saturday.
Mail Orders add *$5.00* to cover postal charges.
Next day delivery in Sydney add $5.00.
All prices INCLUDE sales tax.
Tax exemption certificates accepted if line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES OR CASH CHEERFULLY ACCEPTED

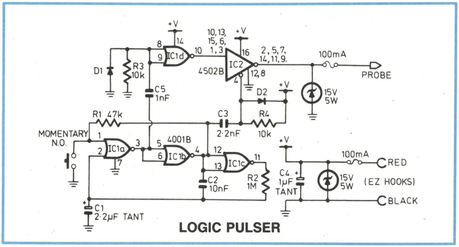


SUPPORT WORLD WILDLIFE FUND AUSTRALIA

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Simple Logic pulser



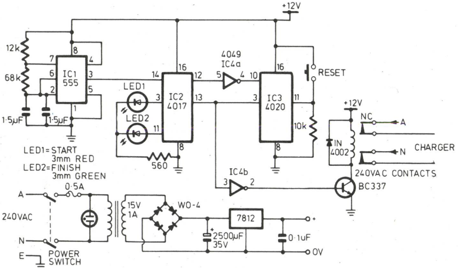
LOGIC PULSER

This simple circuit uses only two common CMOS integrated circuits, yet gives excellent performance. When the normally-open momentary switch is depressed, the probe produces a single pulse of duration approximately 5 microseconds, of a level opposite to the pre-existing state of the node under test. If the finger is held on the switch, after a short pause the probe produces a continuous train of pulses at about 50Hz, each pulse of 5 microsecond duration.

The momentary switch could be a touch-switch, if R1 is changed to a large value, say 10M, and a path through the finger is provided to earth, say via a metal casing for the pulser. The loop formed by the three 4001B gates is an oscillator.

Initially, C1 is completely discharged, which is the normal state when no pulses are being produced. Depressing the switch puts pin 11 high, charging C1 through R2. When C1 reaches the threshold voltage into pin 2, pin 4 flips high, and pin 11 low. The action of pin 4 going high causes C2 to inject a charge into C1, raising its voltage slightly above pin 2's threshold. C1 discharges through R2, and when C1 falls to the threshold again, the gates again flip, causing C2 to extract a small charge from C1, pulling C1 slightly below the threshold. Pin 11 is at this point in time high, and causes C1 to charge back toward the threshold through R2. C2 introduces a hysteresis into the operation, to ensure oscillation, and adjustment of C2 can set the continuous pulse frequency.

The reason that the oscillator produces one pulse, followed by a delay before the continuous pulse-train starts, is that initially C1 must charge from zero volts, to reach the threshold; thereafter it oscillates about the threshold by only a small amount, as set by C2.



TIMER

14H battery charging timer

This circuit was designed to automatically switch off a NiCad battery charger after the appropriate period of 14 hrs.

The circuit is based on an analog timer followed by counters, used to provide the relatively long timing period. In detail, IC1 (555) is operating in the astable mode oscillating at a frequency of 3.24Hz. This signal is fed into IC2 (4017) and further divided by a factor of 10, thus giving the desired frequency of 0.324Hz.

This output frequency is taken from pin 12 or IC2 and is inverted by IC4a, then fed into a 14 stage binary counter. After 16384 pulses (214), pin 3 of IC3 will go high hence switching the transistor and relay on via IC4b. Pin 3 of IC3 is also directly connected to the clock

R1 is necessary to stabilise switch operation and ensure clean pulses.

The CMOS 4502B is a hex inverter package, with a tri-stage control. Here all six inverters are connected in parallel. Pressing the switch causes pin 4 on the 4502B to become active (low) for about 10 microseconds, via the timing circuit of C3 and R4. At (almost) the same instant that the switch is depressed, pin 3 of the 4001B goes high, which generates a 5 microsecond high-pulse out of the probe, via timing-circuit C5 and R3, followed by a 5 microsecond low output, until control-pin 4 disengages the probe output. The delay before continuous pulses start can be modified by adjusting C1, though that will also affect the continuous frequency, requiring a compensatory adjustment of C2.

The probe works from the supply rail of the system under test, and has fuses and zeners to make operation mistake-proof. Voltages greater than 15V applied to the probe of EZ-hooks will blow the appropriate fuse, as will accidental reverse polarity. Miniature fuses could be used, or short lengths of fuse-wire soldered directly into the circuit. The prototype was mounted in a whiteboard marker-pen case. To conserve space, it was found that a construction technique of wire-wrapping directly onto the IC and component pins, worked admirably.

Barry Kauler,
Tincurrin, WA.

$50

---

disable of IC2, hence terminating the timing period until the reset button is pressed.

With the values shown, a timing period of approximately 14 hrs is achieved. However, this timing period can be changed by varying the input frequency or the binary output or both. The frequency for this circuit was calculated using the formula

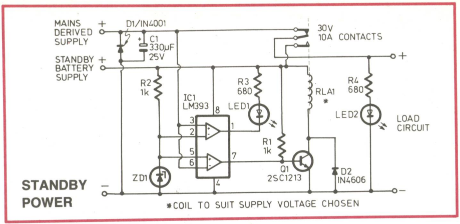
$$f = 2^n / T$$

where f = frequency; n = binary exponent and output; T = timing period in seconds.

Finally, LED1 indicates the start of the timing period whilst LED2 will indicate when the charging is finished. During the operation, these LEDs will flash alternately. A master reset is also added to ensure flexibility of usage.

Alfred Fong
Carlingford, NSW

$30



*COIL TO SUIT SUPPLY VOLTAGE CHOSEN

Standby power supply monitor

The function of this circuit is to monitor the output of a mains-derived power supply circuit, and switch in a standby battery supply if the power supply output falls below a predetermined level. It can thus be used to ensure an uninterrupted power supply for alarm circuits, electronic door locks, security lighting and process control equipment.

Operation is automatic, and when the mains-derived power supply output is restored the circuit switches over again from the battery supply. Two monitor LEDs are provided, one to show when the battery supply is switched into circuit (LED1) and the other monitoring load voltage (LED2).

IC1 is an LM393 dual open-collector comparator, which monitors the mains-derived input voltage. The comparator circuit itself is powered by the standby battery supply, to prevent any malfunction. D1 is for input protection, while C1 is for filtering and noise suppression, and also acts as a reservoir on the output of the main supply. Q1 is used to drive the switching relay from the comparator output, while D2 is to suppress inductive spikes generated by the relay coil. R1-4 are for current limiting.

Zener diode ZD1 provides the reference voltage against which the main input supply is compared. By selecting a suitable zener diode the circuit's switching threshold can thus be varied anywhere between 2.4V (1N4370) and 12V (1N759).

Ranjit Singh,
Pahang Darul Makmur,
Malaysia.

STOLEN

AMATEUR RADIO TRANSCEIVER

On the evening of May 20 last, an advance sample of the new Icom state-of-the-art model IC-781 all band HF amateur radio transceiver was stolen from the Sydney home of EA's Managing Editor, where it had been taken for review.

The IC-781 transceiver concerned carries the serial number 1024.

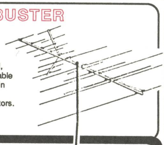
Readers who may be offered this equipment for purchase, or are otherwise made aware of its location are requested to assist in both its recovery and the apprehension of those responsible for its theft, by contacting Constable Bush at Rockdale Police Station, on (02) 597 2222.

JAYCAR No.1 FOR NEW & EXCITING PRODUCTS

SUPER GHOSTBUSTER

This brand new "Top of the Line" UHF/VHF TV antenna will really drag in those signals. Suitable for VHF 0-11 and UHF band 4 (SBS). Australian designed and manufactured, 3 year warranty on workmanship. Suitable for all Australian capital cities. High gain with reflector for fringe areas. Powdercoat blue boom with red insulators.
Cat. LT-3151

$129.00



HI QUALITY AUDIO LEADS

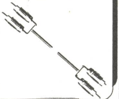
As technology improves the humble Hi Fi has really "turned the corner" in recent years with the advent of compact disc players, Mosfet amps., etc.
In keeping with these changes we have introduced three high quality audio connector leads, so all that technology is not lost by using inferior grade connecting cables.
We have chosen these leads after evaluating what's available on the market. The criteria we have used is based on the best quality we could find, but at a reasonable price. The real audiophile may be able to justify leads priced at $100 plus, but quite frankly, we feel the TECHNICAL Hi Fi connoisseur will be more than happy with the leads we have selected.

GOLD SHIELDED 2 RCA TO 2 RCA PLUGS

1 metre long	Cat. WA-1045	$16.95
2 metres long	Cat. WA-1046	$19.95

OXYGEN FREE COPPER SHIELDED
A densely braided oxygen free copper (OFC) audio cable moulded together with colour coded L/R and centre ground wire.
2 RCA TO 2 RCA PLUGS

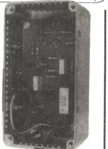
1 metre long	Cat. WA-1050	$35.95



NEW TRANSISTOR IGNITION

Ref: Silicon Chip May/June 1988
A high energy ignition system which uses the cars existing ignition coil and points. Unit has extended dwell and is compatible with both our Hall Effect and Opto Sensors. In fact, all components to interface both these are now included free in the TAI kit. Complete kit with diecast box and all components and interface components.
Cat. KC-5030

$49.95



OPTION 1

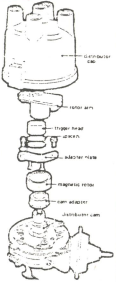
BREAKERLESS (HALL EFFECT) SPARKRITE SYSTEM

Ref: Silicon Chip June 1988
A professionally engineered electronic ('breakerless") contact breaker system. Yes, only Jaycar has a complete Hall Effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:

- Hall Effect Triggerhead
- Magnetic rotors for both 4 & 6 cylinder cars
- Over 6 cam-lobe adaptors
- Over 12 different adaptor plates for your particular distributor
- Other hardware (i.e screws, etc)
- You can remove this system and re-equip your car with the original breaker points when you sell the car!
- As easy to install as a set of points
- Instruction (simple to follow) included

This set is designed to fit most European and Japanese cars. In fact, it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco, or Autolite electrics. If you wish you can check first by sending a SAE for a car/distributor list.
Cat. KJ-6655

$39.95



OPTION 2

SIEMENS HALL EFFECT CONVERSION

Ref: Silicon Chip June 1988
If you have a car that will not take the very comprehensive KJ-6655 Hall type breaker point set, then this device is for you. German made Siemens HKZ-101 Hall Effect switch. Interface components included in TAI kit.
Cat. ZD-1980

$34.95

Tantalum Capacitor Pack

Tantalums are getting more expensive all the time. Due to a very large bulk purchase, we can offer you a mixed pack of over 50 Tantalums. Over 40 of these are tag type, and the rest high quality military spec RT style which are worth up to $5 each.
A typical pack will include: TAG STYLE 2 x 0.33/35V, 10 x 2.2/16V, 5 x 6.8/6.3V, 1 x 0.15/50V, 20 x 4.7/16V, 1 x 4.7/25V, 3 x 68/10V, 1 x 100/16V. RT STYLE 1 x 0.1/35V, 1 x 0.22/35V, 1 x 0.33/35V, 1 x 0.68/35V, 6 x 15/20V, 1 x 32/35V, 1 x 47/20V. We reserve the right to make changes if stock shortages occur. This is a once only offer. Don't miss out.
OVER 50 TANTALUMS FOR ONLY $12.50
Over $35 worth of Tag Tantalums alone, without taking into account the expensive Milspec style also supplied.

Cat. RZ-6695

$12.50 SAVE OVER 60%

BARGAIN RF CHOKE PACK

Over 50 pieces supplied!
A pack of 30 brand new RF chokes with at least 14 different values! Popular values include: 1.5, 4.7, 12, 15, 18, 22, 68, 100 & 1000uH. Each choke is resin dipped and colour coded (they look like bead tantalums). A colour coding chart is supplied so that you can decipher the value.
BONUS! Not only do you get 30 useful chokes we will give you at no extra charge at least another 30 more RF chokes! These are genuine chokes but are commonly called 'peaking coils'! They look like a 1/2 watt resistor. (Read the choke value in uH as you would a resistor value).
Cat. RC-5600

ONLY $10.00

Less than 10¢ a part!

BREADBOARD JUMPER KIT??????

We supply a pack with 5 metres of both red and white solid core hook-up wire. This is the ideal size for breadboards. All you need to do is cut it up into whatever lengths you require and strip the ends. Don't pay lots of money for pre-cut wire in a plastic box.
Cat. WH-3030

ONLY $1.95

FERRIC CHLORIDE

Two sizes, conveniently packed in a plastic jar for easy storage with a childproof cap. Use only as you require, and simply store the rest until needed. Supplied with instructions.

200g	Makes 1 litre	
Cat. NC-4252		$4.95
400g	Makes 2 litres	
Cat. NC-4254		$7.95

ATTENTION OWNERS OF SCANDIA DESOLDERING TOOLS

We stocked this 240V desoldering tool last year (see 1987 cat p.88) There are many 'in the field' and they were also sold under other brand names.
We have a quantity of tips leftover, and can offer these at a saving of almost 50%.
Cat. TS-1581

WAS $9.95
ONLY $5.00

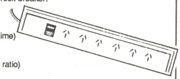
6 WAY POWER OUTLET WITH MAINS FILTER

Not only is it a 6 way power board, it incorporates a voltage surge and spike protector and noise rejection filter network. Supplied with two metre cord and mains plug, safety shutters on each outlet, illuminated master on/off switch and even a safety circuit breaker.

SPECIFICATIONS

Max clamping voltage	775AC @ 50A
Spike dissipation energy	80J @ 2ns
Withstanding surge current	4500A (8 x 20us, 1 time)
Clamping response time	<10-9 ns
Frequency	1kHz - 100MHz
Attenuation	20 to 40dB (variable ratio)

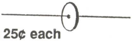
Cat. MS-4030



$59.95 NOTE: If you require absolute mains suppression don't forget our Australian made Squeeky Clean Mains Filters.

CERAMIC MAINS SUPPRESSION CAPACITOR BARGAIN

470pF 400V AC ceramic capacitor. Ideal for mains suppression.
Limited quantity
Cat. RC-5375



BARGAIN PRICE **25¢ each**
10 for $2.00

NEW HEAVY DUTY SPEAKER FLEX

Don't pay through the nose for heavy duty speaker flex. High quality figure 8 speaker cable 2 x 79/0.2mm strands in a white covering with black trace.
Cat. WB-1712

$1.50 metre
$120 per 100m roll

PHILIPS GENERAL CATALOGUE

1988 Edition NOW AVAILABLE - Brand new! Just released!
Line data is provided on the full range of preferred Philips products including: Logic, memory, analogue, radio, audio, video, semiconductors, tubes, capacitors, resistors and other materials including speakers, etc. 1.25 inches thick. Dimensions 210 x 145mm.
Cat. BP-4402

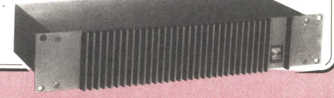
$25.00

5000 POWER AMP "BLACK MONOLITH" RE-BORN WITH TOPOLOGY MODULES

- Jaycar proudly re-introduces the fantastic 5000 series power amplifier with the new "state-of-the-art" Topology Power Modules.

Get the upgraded module performance for the same price as the old 5000 amp.
Cat. KE-4200

$499.00



JAYCAR No.1 FOR BARGAINS

PUSH BUTTON WALL MOUNT PHONE WITH AM/FM RADIO!

Scoop purchase price! An AM/FM radio with good tone that mounts on the wall (kitchen or garage ideal). When the phone is answered the music mutes out. You can even put the music on the line if you need to put the caller on hold! Requires 3 x AAA batteries, not supplied).
Cat. YT-7072

WAS $39.95

NOW ONLY $20.00

SAVE 50%

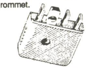
TELEPHONE PLUG BARGAIN

SAVE 50%

Another surplus stock purchase. These are standard type telephone plugs without the cable grommet.
NORMALLY $3.95
Limited quantity
Cat. PP-1400

ONLY $1.95 ea

10 up $1.75 each



TELEPHONE DOUBLE ADAPTOR SENSATION

Another jaycar exclusive purchase. Allows you to connect two phones to the one socket. These normally sell for $7.50

SAVE 47%

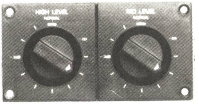
Cat. XT-6020

$3.95 ea

MIDRANGE AND TWEETER LEVEL CONTROL BARGAIN

This unit is designed for midrange and tweeter control on multiway speaker systems. It is suitable for systems up to 80 watts power handling capacity. It presents a constant 8 ohm impedance to the load, and so does not disturb the crossover points. Unit is fully sealed, mounting plates and is labelled high and mid with rotary controls. Both high and mid are in the one unit, and we can offer these far below the normal price.
Cat. AC-1683

ONLY $9.95 each



TI CALCULATORS AT SELLOUT PRICES

TI-1103

- eight digit,
- six function

Cat. QC-7172

ONLY $10.95

SAVE $4

Little Professor

Learn maths tables plus addition, subtraction, multiplication and division. Comes with Activity Book.
Cat. QC-7160

ONLY $25.95

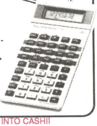
SAVE $9

TI-56 Programmable

Ideal for Tech Students. Factorials • imperial to metric conversions (or visa versa) • engineering and scientific notation • integration • statistics • polar/rectangular conversions • stores a constant (even when off) • algebraic operating system - operates in proper mathematical order • 8 digits and 2 exponents • degrees • radians • grads.
Cat. QC-7174

ONLY $39.95

SAVE $10



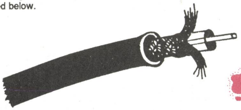
TURN YOUR SURPLUS STOCK INTO CASH!!
Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.
CALL GARY JOHNSTON OR BRUCE ROUTLEY NOW ON (02) 747 2022

1/2 PRICE TV COAX

Another Jaycar scoop purchase!! Installers please note!! Quality AIR SPACED coax at 1/2 our usual price. Available in 4 different roll lengths. Normally sells for $1.20 per metre. Special price only applies to purchases of full rolls as listed below.

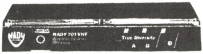
50 metre roll	Cat. WB-2020
ONLY $30	**SAVE $30**
60 metre roll	Cat. WB-2021
ONLY $36	**SAVE $36**
65 metre roll	Cat. WB-2022
ONLY $39	**SAVE $39**
70 metre roll	Cat. WB-2023
ONLY $42	**SAVE $42**

(Available early July)



DIRT CHEAP!!

GENUINE FM DIVERSITY WIRELESS MIC/ GUITAR LINK SELLOUT



You would DIE if you knew where we bought this shipment of brand-new genuine US-made NADY wireless PA gear from! Suffice to say that they lost a fortune to liquidate this current model merchandise. ONCE AGAIN their staggering loss is YOUR GAIN.

OFFER No1 SAVE AROUND $200

Genuine NADY MODEL 201GT Guitar wireless microphone link which includes FM "True Diversity" receiver, bodypack transmitter with high impedance input (suitable for guitar pickups, bass, sax, etc). The body pack accepts a standard 6.5mm plug and the audio lead acts as the antenna, neat! The body pack measures 96 x 60 x 203mm and weighs only 70 grams. It requires a 9V alkaline battery. Both transmitter and receiver are crystal locked and offer 20-20,000Hz ±3dB frequency response and 120dB (max SPL A-weighted) dynamic range. Output is line level 600 ohms. Minimum adverse operating range 200 feet, line-of-sight 1500 feet. Elsewhere you will pay $800+ for this system in Australia. But, while they last you will be able to get this product from us for only $599! That's right, you WILL SAVE around $200 over the normal price in Australia! (Australian rec. retail $799).
(If more than one is ordered, they will be supplied as separate frequencies).
Cat. DT-5020

$599 INC tax

OFFER No2 SAVE AROUND $300

Genuine NADY 201HT microphone wireless system comprising of YD-04 microphone (virtually identical performance to Shure SM-58), integral antenna (no dangling wires) low battery light and professionally rugged. Measures 222(L) x 36(Dia)mm weighs 238 grams. Use 9V cell. Included of course is the 201 "True Diversity" receiver matched to the same frequency. System performance and range similar to 201GT above. (You see this system used by TV entertainers in the US all the time!)
(If more than one ordered or 1 x 201GT and 1 x 201HT ordered they will be supplied on different frequencies).
Cat. DT-5030

$699 INC tax

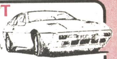
TECHNICAL BOOK CLEARANCE

For full details see our 1988 catalogue.

		Was	Now
BS-0720	Fibre optics experiments & projects	$26.95	$19.95
BS-0730	How to read schematic diagrams	$27.50	$19.95
BS-0422	Computer connections solved	$37.95	$27.95
BS-0406	Soul of CP/M	$39.95	$27.95
BS-0456	Understanding microprocessors	$27.95	$19.95
BS-0416	Macintosh programming techniques	$44.50	$29.95
BS-0404	Intro automotive solid state	$19.95	$14.95
BS-0458	Understanding digital electronics	$27.95	$19.95
BS-0590	8080/8085 software design	$24.95	$14.95
BS-0420	C prog. techniques for Macintosh	$37.95	$25.95
BS-0453	Basic electricity 6 cassettes	$26.50	$16.50
BS-0732	Complete guide - car audio	$19.95	$14.95
BS-0703	Crash course digital technology	$34.95	$24.95

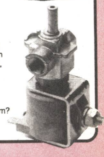
SAVE UP TO 35%

FUEL CUTOUT SOLENOID



Who needs a noisy car alarm, after you have installed one of these in your vehicle. It's operated from a hidden switch. Simply turn it on when you leave your car, and if your car is stolen, it won't go very far without any petrol. Supplied with instructions, pre-wired switched, hardware and even two alarm stickers. Quality MED Alarm brand. Add to this our deluxe red light flasher kit - KJ-7000 $19.95, and who needs an alarm?
Cat. XC-2050

$69.95



"BICENTENNIAL" LIGHTS IN YOUR OWN HOME!

NEW '88

Illuminate your garden, trees or windows with this low volatge lighting system!

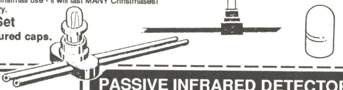
Now you can have the same beautiful 'firefly' lighting that is all over the civic squares around Australia. The beautiful lights of Hyde Park and Macquarie Street in Sydney, for example can now be in YOUR front garden. If you have ever travelled to the USA you see such 'firefly' lighting in trees, around motels, houses etc - all over the place!

Until now weatherproof outdoor low wattage festoon lighting simply has not been available. That is behind us, because Jaycar has an exclusive outdoor/indoor lighting kit to enable you to beautify your home or garden. Each festoon set comprises a 6 metre cord with 20 lamp bases moulded in parallel onto the cord at 300mm intervals. (At the end of the festoon is a clear 700mm of cord.) Each lamp base is fitted with a 12V 50mA globe and clear polycarbonate weatherproof cap. The entire festoon draws, of course, 1 amp AC or DC, only. THE RATED LAMP LIFE IS 20,000 HOURS! 'Pixielites' as we call them can be connected in a chain for larger installations. Each lamp is in parallel and in the likely event of an individual bulb failure THE REST STAY ON (unlike cheap series type festoons). All that is required for larger installations is 1 amp extra of power supply capacity for every 6 metre festoon. The 'Pixielite' festoon is moulded in water clear plastic. This enables you to line home or shop windows with Pixielites and only see the lights! The clear plastic makes the wiring almost impossible to see in foliage as well!

At one amp per festoon a cheap 2155 type transformer (Cat. MM-2002 $10.95) is all you need for power. But if you have a trickle battery charger or old CB power supply you ALREADY have power! The festoon, however, is NOT CHEAP. It is a quality made in Australia product designed to last a lifetime. (Maybe for the Tricentenary?) A 6.7 metre 20 lamp festoon will cost you $49.95. You can buy a mixed bag of coloured caps (red, amber, green, blue, 5 of each) to convert the festoon for Christmas use - it will last MANY Christmases!

So act now and participate in Australia's Bicentenary.

Cat. SL-2802	**$49.95 Festoon Set**
Cat. SL-2805	**$9.95 Bag of 20 coloured caps.**



CLOCK MOVEMENT WITH BUILT-IN PENDULUM DRIVER

This module measures 87mm long x 55 wide x 35mm deep and uses 1 x AA battery. Clock movement is supplied with 3 sets of hands, and pendulum is a suspended arm within the module which swings back and forth. A suitable pendulum can be attached to the bottom of the arm.

Fit your own custom clock face. Great for novel applications.

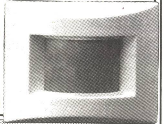
Available sometime in June.

Cat. XC-0103

$22.95

PASSIVE INFRARED DETECTOR PRICE BREAKTHROUGH PULSE COUNT PIR FOR UNDER $100

It had to happen, and Jaycar is the first to offer you a quality PIR with pulse count for under $100.



Features:
- Coverage 12 metre x 12 metre
- Detection angle 110°
- Detection beamss - 38
- Adjustable angle
- Tamper proof protected
- N/C and N/O output

Cat. LA-5017

ONLY $99.95

DUMMY CAMERA BARGAIN

We all know that shoplifting and vanalism cost a small fortune very year. It has been demonstrated that television surveillance cameras in the right environment can discourage this activity.

This is where you come in. We have made a great purchase of realistic-looking Dummy TV Cameras. They are Australian made, are supplied with adjustable swivel mounting bracket, fixing screws, flashing LED circuit board and 2 flashing LEDs. Also supplied is the 2 x D cell nylon battery holder to power the flasher circuit. A fake cable wallplate is also supplied as well as a very conspicuous 210(W) x 160(H) self adhesive sign which says "THESE PREMISES ARE PROTECTED BY TIME-LAPSE ANTI-THEFT CAMERAS" The text of the sign is in orange-red fluorescent ink against a black background.

BUT HURRY! We have around 300 only.

Cat. LC-5310

1 - 4 pieces	$49.95
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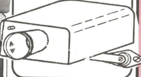
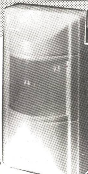
20+ pieces	$37.95



TERMINATOR PIR WITH PULSE COUNT



Jaycar are proud to announce a new PIR to our range. The Terminator has features found in those really expensive PIRs.

FEATURES
- Pulse count which virtually eliminates false alarms
- 48 detection beams in 3 ranges
- Sliding PC board for pattern adjustment
- Optional lens for use in hallways
- Tamper proof protected
- Plus all the usual features of PIRs.

Cat. LA-5018

$119.00 Hallway Lens Cat. LA-5020 $3.95

DIGITAL AUTO TUNE UP TESTER

Not only will this measure RPM & dwell (on 8, 6, 5 and 4 cylinder cars) it measures AC volts, DC volts, points resistance, diode check and even has ohms range. But its best feature is the nifty little tacho adaptor supplied. It is a clamp type unit with coiled lead. Simply connect the inductive pickup to the coil HT lead and the RPM's are displayed.

For full specs see our 1988 catalogue.

Cat. QM-1573

$139.50

DIGITAL L-C METER

Quality inductance and capacitance digital meter. Capacitance range from 2nF to 200uF in 6 ranges. Inductance range from 2mH to 20H in 5 ranges.

For full specs see our 1988 catalogue.

Cat. QM-1575

$219.00

DIGITAL AC CLAMPMETER

Quality 400 amp LCD clampmeter with digital hold facility. High impact case. Full specs in our 1988 catalogue.

Cat. QM-1570

$139.95

"PLASTI-DIP"

HEAVY DUTY FLEXIBLE LIQUID COATING

Plasti Dip is an air dry liquid plastic coating that produces a tough, thick pliable finish. It is virtually impervious to the elements and has a good dielectric strength. It is ideal for making a pliable coating for the handles of tools, etc. It also provides excellent environmental protection for circuit boards, etc. Supplied in a 470ml dipping can. Will do dozens of tools.

Red in colour.

Cat. NP-1100

NOW AVAILABLE

$24.95

AIR DUSTER

It's pure compressed inert gas for removal of dust and air borne contamination from very delicate and inaccessible areas of electronic and electrical equipment.

400ml spray pack - 550g nett.

Cat. NA-1018

$12.95

MINI MUFF PADS

Foam earpad replacements for mini headphones. 27mm diameter - 2 pairs.

Cat. AA-2012

$3.75 pair

Adel Nibbling Tool

Born in the USA

How things change. You can now purchase from Jaycar the original American Adel nibbling tool. Due to price rises from Asian countries we've been able to direct import the original tool (which we sold 10 years ago) and sell it at the same price as the Asian copy.
- Cuts holes - any shape over 7/16"
- Notches clearance for plugs and wiring
- Trims undersize holes to fit parts
- Suitable for steel up to 18 gauge, Aluminium 16 gauge, plastic and copper

Cat. TH-1765

$29.95

Replacement Punch

Cat. TH-1766 **$21.50**

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JAYCAR No.1 FOR NEW KITS

Discolite

Ref: Silicon Chip July 1988

Build your own light show. More features than the Musicolor. New design.

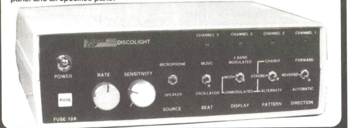
- 4 light channels controlled by 4 separate audio channels
- Forward, reverse and auto-reversing chaser patterns
- Simultaneous strobe on all four channels
- Alternating light patterns
- Music modulation available on chaser, strobe and alternate patterns
- Adjustable rate for light patterns
- Inbuilt microphone for beat triggering or audio modulation of lights
- Direct inputs for beat triggering or audio modulation of lights
- Sensitivity control
- Presettable sensitivity levels for each channel
- Front panel LEDs mimic light display

The Jaycar kit includes punched and screened front panel, punched and anodised rear panel and all specified parts.

NEW '88

Cat. KC-5032

$159.50



STROBOSCOPIC TUNER

$47.50

Ref: EA July 1988

This simple circuit provides crystal-locked accuracy for tuning virtually any musical instrument.

It also doubles as a stable frequency reference if you prefer to tune up by ear. Kit includes box and all parts.

Cat. KA-1705

STUDIO 200 HI FI PREAMP

Ref: Silicon Chip June/July 1988

The new Studio 200 Preamp offers excellent specifications and features for a very moderate price.

Main Features

- Very low noise on inputs - less than many CD players
- Very low harmonic and intermodulation distortion
- Up to 7 stereo program sources can be connected
- Tape monitor loop
- Separate high quality headphone amp
- Headphone socket disables output signal to power amp
- Tone and balance controls
- Easy to build construction

NEW '88

SPECIFICATIONS

Frequency Response: Phono inputs RIAA/IEC ±0.3dB from 20Hz to 20kHz; High level inputs within ±1dB from 10Hz to 100kHz

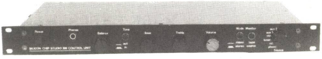
Total Harmonic Distortion less than 0.005%, 20Hz to 20kHz, at rated output level for any input or output

Signal-to-Noise Ratio phono (moving magnet) 86dB unweighted (20Hz - 20kHz) with respect to 10mV input signal at 1kHz and rated output. High level inputs (CD, Tuner, etc) 104dB unweighted (20Hz - 20kHz) or better, with respect to rated output (with volume at maximum).

Separation between Channels -62dB at 10kHz; -81dB at 1kHz; and -93dB at 100Hz with respect to rated output.

Cat. KC-5033

$229.00



240 VOLT LINE FILTER

Cat. KA-1703 **$39.95**

Kill those clicks and pops from next doors vacuum cleaner or lawn edger etc. Kit includes 240V socket and plug, PCB, all components and hardware.

ACTIVE CROSSOVER

Ref: ETI June 1988

Short form kit includes PC board and all on board components. Transformer is extra Cat. MP-1012 $19.95.

Cat. KE-4733

$39.95

FM RECEIVER

Ref: EA June 1988

A simple and inexpensive FM receiver, using only two chips, one of which is an audio amp. Kit includes PCB, box, panel, planetary reduction drive, TDA700 chip and all components.

Cat. KA-1704 **$55.00**

RF DETECTOR PROBE

Ref: EA May 1988

This simple but very effective RF probe enables you to troubleshoot RF circuits. You can 'trace' RF just like audio!

Kit includes all specified parts except the felt tip pen case. The project must be used in conjunction with the KA-1699 Bench Amp ($39.95) described in April 1988 EA.

Cat. KA-1701

$13.50

LOW COST 50MHz 4 DIGIT DIGITAL FREQUENCY METER

Ref: EA May 1988

A low cost but high sensitivity, high input impedance unit measuring to well over 50MHz. Kit includes case, front panel and all specified parts.

Cat. KA-1702 **$99**

NiCad CHARGER

Ref: AEM April 1988

Will fully charge then trickle charge - or trickle charge only. Will charge up to 10 cells at once. Incorporates own plug pack box.

Cat. KM-3067 **$24.95**

LINE GRABBER

Ref: Silicon Chip March 1988

Handy gadget cuts out one telephone extension when the other is picked up. No eavesdroppers. One unit required for each extension.

Cat. KC-5025 **$19.95**

SIMPLE TESTER FOR POWER TRANSISTORS

Ref: EA May 1988

Kit will measure current gain and Vbe of all popular power transistors - even Darlingtons! All project specified parts in the kit.

Cat. KA-1700 **$22.95**

BABYMINDER

Ref: ETI April 1988

Monitor your baby's room for crying. Will trigger a light or buzzer in another room. Kit includes box, PCB, and all components except 12V AC plugpack and dynamic mic.

Cat. KE-4732 **$34.95**

BENCH AMP/SIGNAL TRACER

Cat. KA-1699 **$39.95**

Ref: EA April 1988

Amplifier offers power output of 5 watts, signal tracer has high input impedance and a wide range of input sensitivities.

Complete kit including box, speaker, PCB and all components. Plug pack not supplied.

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Construction project:

Stroboscopic Tuner for musicians

This simple circuit provides crystal-locked accuracy for tuning virtually any musical instrument, using an inexpensive LED display. It also doubles as a stable frequency reference if you prefer to tune up by ear.

by MARK CHEESEMAN

A tuning fork was usually the only way to tune a musical instrument, before the days of electronic tuners. When struck, the tuning fork emitted a tone which was then compared by ear to the sound of the instrument being tuned. The musician would then adjust the tuning of his or her instrument while listening to the beat frequency between the two sounds. When the beat frequency became too low to notice, the instrument was tuned.

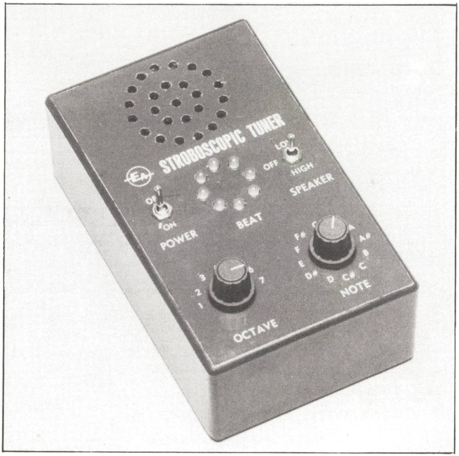
This is fine for instruments where there is only one adjustment for tuning. One simply tunes one note, and all the others follow suit. However many instruments (mainly stringed instruments) are not this easy to tune, as each note has a separate string (or even more), which need to be tuned separately. Carrying 88 tuning forks around to tune a piano would be impractical, to say the least. Not only is the sheer number rather daunting, but the size of the forks required to tune the lowest notes would be enormous, and the smallest would be so small as to be virtually unusable, if you didn't lose them first!

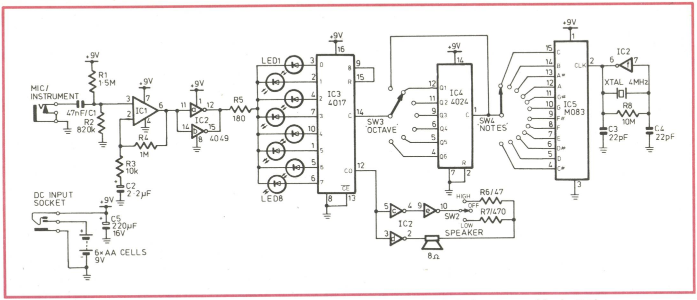
Instead, a piano tuner will usually tune one note with a tuning fork, and then uses his well-trained ears to tune the other notes so that they bear the correct relationship to the "standard". Obviously, this requires considerable experience and a lot of patience.

For those who do not trust their ears this much, an easier way is to use an electronic tuner. These usually contain an inbuilt crystal reference, which is divided down in frequency by a preset amount and compared with the incoming signal, and displayed on, say, a meter movement.

Our last musical frequency standard, published in July 1980, used a rotating LED display to show whether the two frequencies were in tune or not. The display rotates in one direction if the instrument is sharp, and the opposite way if it is flat. The faster the rotation the more out of tune the instrument is. When the display is stationary, the tuning is correct.

The primary advantage of a LED display is cost, as meter movements are getting more expensive all the time. Meters are also prone to damage unless a lot of care is taken to physically protect them. The LED display, on the other hand, is virtually roadie-proof!





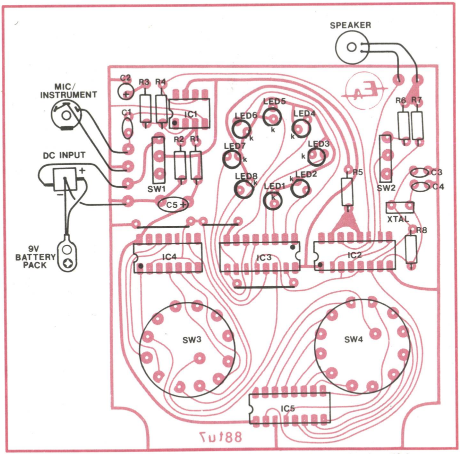
CMOS ICs are used in the circuit to minimise power consumption, allowing it to be powered by batteries.

We were considering an updated version of the 1980 design when we noticed a similar device in a recent issue of *Elrad* magazine, from Germany. What immediately grabbed our attention was the rather clever way in which the LEDs were driven. Instead of using an up/down counter as in the previous *Electronics Australia* design, the reference frequency and the unknown are both fed directly to the LEDS.

A circle of eight LEDs is used as the display. The anodes of these are driven one at a time, in sequence, by a counter clocked at eight times the frequency of the note to which the instrument is to be tuned. Thus, the light source would seem to rotate full circle once every cycle of the reference frequency. On it's own, this would not be of much use to anybody, even if your eyes were fast enough to see it!

Now for the clever bit (there's always a clever bit in electronic projects!). The cathodes of all the LEDs are connected together, and driven by the incoming "unknown" signal. This results in a visual display of the difference between the two frequencies. If the two frequencies are exactly the same, then during the time it takes for one complete cycle of the unknown signal, the counter driving the anodes will have completed one complete cycle through the eight LEDs.

Thus, the same LED or LEDs will remain alight continuously. In fact, it is being pulsed at the frequency of the relevant note, but persistence-of-vision convinces us that the LED is continuously lit (except for very low frequencies, which are musically irrelevant anyway).



Virtually all components mount directly on the board, greatly simplifying construction.

If the frequencies are slightly different, then the display will appear to move one way or the other, depending on which frequency is the highest of the two. This is a manifestation of the same stroboscopic effect which causes moving wheels in movies to appear to rotate backwards.

In the design presented here, we have endeavoured to combine features of both the 1980 EA design and the Elrad design, to make the tuner useful to as wide a variety of musicians as possible. It covers the full chromatic scale, and has a useful range of over 7 octaves. Most of the bottom octave is too low to be of much use musically, but the top four semitones in this octave cover the bottom four keys on a piano keyboard.

I can hear some readers questioning my mathematics at this point already. How can an instrument with only seven octave selections, cover *more* than seven octaves when most of the bottom octave is unused?

The extra octave's range arises from a clever trick that can be pulled (if you'll excuse the expression) on any range, but is of most use on the top octave. If you set the tuner's octave switch to one octave below the frequency of the instrument, then the display will show two points of light rotating around the circle rather than one. This turns out to be just as easy to adjust as before. Therefore, on the top octave range, you can tune notes one octave higher again, which covers the top octave of a piano keyboard.

The Circuit

The circuit presented here is based around four digital ICs and a single op-amp.

The input signal (from a microphone, or direct from an electronic instrument) is capacitively coupled to the non-inverting input of IC1 by C1. R1 and R2 bias the input to the op-amp to a voltage of around 3V, rather than the more usual half-rail voltage. This is to ensure that the LEDs remain off in the absence of an input signal. These resistors also set the input impedance to about 500k, which should be high enough for just about any application.

R3 and R4 set the gain of the input pre-amplifier to 100, to ensure adequate sensitivity for low signal levels. High signal levels will cause the input stage to go into clipping, but this is hardly a problem in this application. IC2a and 2b buffer and invert the output from the input stage, and drive the cathodes of the LED display.

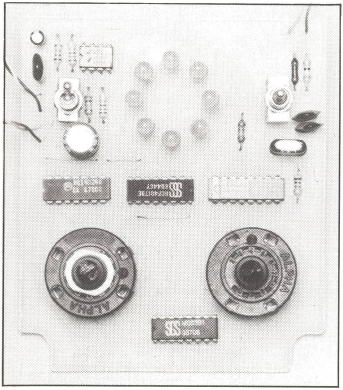
A crystal oscillator based around IC2f provides a stable 4.000MHz frequency reference from which the frequency for each note is actually derived. This is performed by IC5, which contains 12 pre-set dividers, and the resulting notes of the chromatic musical scale appear on pins 4 to 15. The desired output is then selected by SW4 and fed to IC4.

IC4 is a normal 7 stage binary ripple counter (although only six stages are used in this application). This means that the frequency appearing on each output is exactly one half of the frequency on the previous output. The frequency that appears on the first output is, of course, half the input frequency to the IC. SW3 selects the desired octave by selecting one of these outputs (or the undivided input) to become the reference frequency.

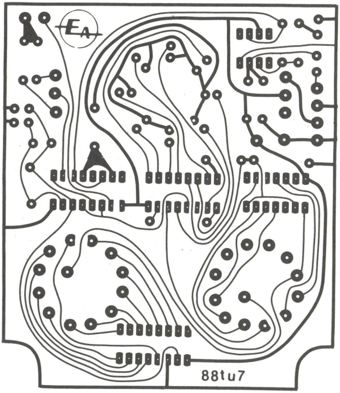
This reference signal becomes the clock input to IC3, a Johnson decade counter. However, it only divides by eight in this application. Since when the instrument is in tune we want one complete cycle through the the LEDs for each cycle of the input signal, we are effectively dividing the reference frequency by eight. This is musically equivalent to a downward shift of three octaves, and allows the use of an easy to get 4MHz crystal.

The *carry-out* pin of IC3 produces a signal of one eighth of the clock input. Thus, the frequency which appears on this pin is the true reference frequency. This is fed to the remaining three inverters in IC2, which form a crude bridge amplifier. Although the drive to the speaker is a square wave, it is still perfectly usable for tuning purposes, and the added complication of filtering was not considered to be worth the trouble.

Switch SW2 allows the internal speaker to be operated at one of two volume levels for tuning by ear, or disabled entirely if it is not required.



Note that IC3 is orientated in the opposite direction to the other ICs.



Above is the PCB pattern, and to the right is the front panel, both reproduced actual size.

Construction

The whole circuit, with the exception of the speaker and battery, is mounted on a single printed circuit board measuring 88 x 102mm, and coded 88tu7.

Begin by checking the board for shorted tracks or hairline fractures. Also, using a round file of about 10mm diameter, file out the two bottom corners in order to clear the mounting pillars in the box. Before mounting any components, check that the holes for the four switches are the correct diameter, and enlarge them if they are not.

The assembly of the PCB is pretty straightforward. Insert the three wire links first, followed by the resistors and capacitors, being careful with the polarity of the two electrolytics. Now mount the ICs, again watching their orientation carefully. Note that IC3 faces the opposite direction to the other ones.

Now mount the two toggle switches. The one with the centre-off position is mounted on the right-hand side of the board. The rotary switches may be mounted next. Both are of the single-pole, twelve-position type, but the *octave* switch should have its special washer inserted so as to restrict its movement to seven positions. The *note* switch should not have this washer in place at all, to allow the full twelve positions of movement.

The mounting of the LEDs should be left until the mechanical details are completed. The housing used for the prototype is an all-plastic jiffy box, measuring 150 x 90 x 50mm. The PCB is supported below the lid of the box by the four switches.

The 6.5mm input socket and the plug-pack connector are mounted on the top end of the base of the box. Before mounting the sockets, attach some short lengths of wire to the connectors to facilitate their connection to the PCB later on. Also connect the battery snap to the plug-pack connector.

Using a photocopy of the front-panel artwork, drill all the holes on the front panel. There are quite a lot of these, due to the presence of the speaker on the panel. It is probably best to drill a small pilot hole first and then enlarge them to the correct sizes afterwards.

When all the holes are the correct size, carefully align the *Dynamark* front panel and stick it on. Using a sharp scalpel or art knife, cut out all the holes for the switches, LEDs and speaker. The easiest way to mount the speaker is to use a strong adhesive and glue it to the back of the front panel.

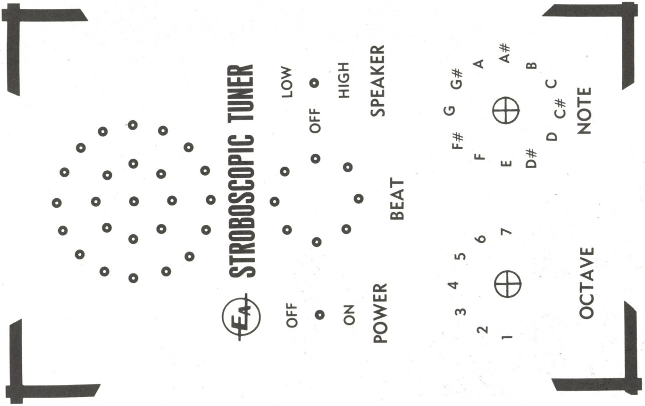
Connect the speaker to the PC board, followed by the two sockets. Also insert the eight LEDs into their holes in the PCB, taking note of polarity; but do not solder them in place yet. Remove the nuts from the four switches and attach the board to the front panel.

Now line up the LEDs with their respective holes and solder them in place one by one, so that they all protrude through the panel by the same distance. All that remains to be done now is to install the battery pack and screw the lid on the box.

Tuning up

There are basically two ways in which this tuner can be used, depending on your own ability to accurately tune one tone to the frequency of another. The first is to simply use the tuner as a frequency reference, and tune the instrument by ear. In this case, you won't need to connect a microphone to the input socket. However if you play in an orchestra/band/rock group you may have trouble doing this accurately if there are lots of people trying to do the same thing all at once.

The other way is to plug a microphone into the input jack and place the microphone as close as possible to the instrument being tuned. Alternatively, if it is an electric guitar or keyboard etc., you can connect the output directly to the tuner input. Adjust the controls on the tuner to select the note to which the instrument



is to be tuned and play the same note on the instrument while observing the LED display.

The LED display will appear to rotate either clockwise or anti-clockwise, depending on whether the instrument is high (sharp) or low (flat) in frequency (pitch). Now all you have to do is to adjust the tuning on the instrument until the pattern remains stationary, or close to it. If the input signal is too low, then the LEDs won't light at all. However we tested the prototype on signals lower than 10mV RMS without any trouble.

Due to limitations on the maximum clock frequency of the top-octave generator chip, the tuner does not directly cover the top octave of a full 88-note piano keyboard. However if the instrument is tuned one octave higher than the tuner, then you will see two groups of LEDs on opposite sides of the circle "chasing each other around". So you can still tune the top octave of a piano in this way, by adjusting the tuning of the instrument until a stationary display is obtained as before.

Actually, tuning high frequency notes using the stroboscopic method is not as easy as for lower notes, because even a few cents difference in pitch corresponds to quite a high beat frequency, so the display will rotate quite fast even when the notes sound almost the same.

In these cases, the best way to tune the instrument is to first get it as close as possible by ear, and then adjust the last little bit using the LEDs. Bear in mind that even if the LED display is rotating a few times per second here, the relative difference in frequency is still quite small.

Now there is one less excuse for those sour notes!

PARTS LIST

1	PCB 88 x 102mm, coded 88tu7
1	UB1 plastic jiffy box, 150 x 90 x 50mm
1	single pole, 12 position PCB mount rotary switch
1	single pole, 7 position PCB mount rotary switch
2	suitable knobs for switches
1	SPDT miniature toggle switch
1	SPDT centre-off miniature toggle switch
1	Panel mount 6.5mm socket
1	2.5mm power socket
1	4.000MHz crystal
1	57mm speaker
1	9V battery snap
1	6xAA cell holder
6	AA cells

Resistors (all 1/4W 5%)

1 x 47ohm, 1 x 180ohm, 1 x 470ohm, 1 x 10k, 1 x 820k, 1 x 1M, 1 x 1.5M, 1 x 10M.

Capacitors

2 x 22pF ceramic
1 x 39nF metallised polyester
1 x 2.2uF 16V electrolytic
1 x 220uF 16V electrolytic

Semiconductors

1	741 op-amp
1	4017B Johnson decade counter
1	4049 hex inverter
1	4024 7-stage ripple counter
1	M083 top-octave generator
8	Red LEDS

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Construction project:

A universal speaker protector

Here's a very flexible module which can protect your expensive speaker system from damage due to a fault in your stereo amplifier. As a bonus it also provides an initial delay, to eliminate turn-on "thump", plus visual indication of overload conditions. You can either build it into your amplifier, or as a separate free-standing unit.

It's quite a while since we described a free-standing loudspeaker protection circuit – November 1975, in fact. Later circuits were built into our very successful stereo amplifier designs, such as the MOSFET Stereo Amplifier of December 1980 – February 1981 and the Series 200 Amplifier of January – May 1985. Needless to say these weren't of much help to people with existing amplifiers, who simply wanted to provide themselves with the same protection facilities.

Why do you need to protect your loudspeakers? Well, most modern hifi amplifiers are DC coupled, to provide optimum performance at low frequencies. This is fine when the amplifier is working correctly, because the biasing and feedback circuits ensure that the speaker is fed only with the correct signals. But if the amplifier should develop a fault, the same DC coupling can result in the speakers being damaged – before you're even aware that there's a problem.

For example if the fault is such as to upset the DC operating conditions of one of the amplifier's output stages, you mightn't notice this immediately in terms of increased distortion. But there could well be a hefty direct current fed into your speakers, and before you know it a nasty burning smell – followed by a very unpleasant bill for a new speaker!

Much the same disastrous result can occur if the amplifier system develops a low frequency instability, and starts feeding massive amounts of almost-inaudible low frequency energy into the speakers.

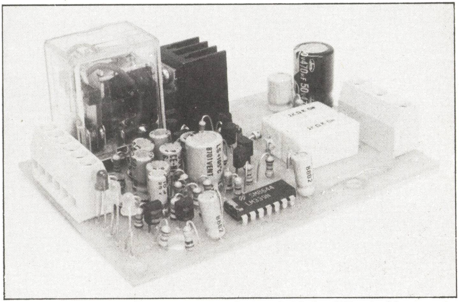
So if you do have an expensive high performance speaker system, and a DC-coupled amplifier that doesn't feature internal speaker protection circuitry, adding a loudspeaker protection unit could be a very sensible investment. The new protection circuit design described in this article has been developed from the original November 1975 design, but with a number of refinements and "frills". Like the earlier design it provides not only protection against DC offset voltages and excessive low frequency drive, but a turn-on delay to provide muting of the initial "thump" often produced when direct-coupled amplifiers are first turned on.

In addition, however, it also provides a dual signal level monitor circuit, with visual indication via LEDs. This can be used as a clipping indicator, to show when the amplifier system has reached its clipping level, or as a warning indicator to show when the amplifier's output level has reached the rated power handling ability of your speaker system.

An added feature of the design is that it can be either built up as a self contained free standing unit, for external use with any amplifier, or left as a small PCB module and built into your existing amplifier – operating from the amplifier's own power supply. It is because of this flexibility that we've called it the "Universal" Speaker Protector.

By the way, the design and development work for this project has been carried out by the R & D Department at Dick Smith Electronics, and as a result the PCB design is proprietary – no other organisation may sell it.

Needless to say, kits for the project will be available through all Dick Smith Electronics stores, and from selected



General view of the unit built up in the form suitable for fitting inside an existing amplifier, and powered from the amplifier.

dealers as well. We understand that the price of a kit for the basic PCB modules will be $37.95.

How it works

To understand how the circuit works, let's look first at the detector stages of the protector section. This is the circuitry around Q1, Q2, Q3, Q4 and Q5.

This section of the circuit monitors the DC component of the amplifier's ouput. Any constant voltage, either positive or negative, as a result of offset or fault condition can cause damage to a speaker system if the level is high enough. It may result in overheating of the voice coil, or it may cause physical damage if the voice coil/cone system is forced to travel beyond its normal range.

With modern balanced solid state, DC coupled amplifiers the output centres around a balanced dual polarity power supply. After power-up and a short period of stabilisation, the output stage should settle to within a few millivolts from the common rail (i.e., "earth").

To cater to this unstable amplifier power-up sequence (that normally results in a "thump" in the speakers), the relay of the monitor remains energised so that the speakers are disconnected. This hold-off period of around 2-4 seconds is provided by the time constant of R8/C5.

After power-up, the regulated 12V supply line is ready within a few milliseconds. C5 is charged from this line via R8. Transistor Q6 will not conduct until the potential on its base reaches the zener breakdown point of ZD1, plus its own base/emitter junction forward bias voltage, around 6.3V. Now with Q6 conducting, Q7 base/emitter junction is forward biased via R10. Q7 now conducts, energising the relay. The voltage across the coil of the relay is also applied to LED LD3, indicating circuit's normal state (via R27).

The front end of the monitor exploits the knee voltage characteristic of a silicon transistor base/emitter junction as the sense element. In this case, the NPN transistors Q1 and Q2 are forward biased and turned on when the input voltage applied to either E-B junction (via R1/R3 or R2/R4) is more *negative* than the common rial by around 0.5V. With either Q1 or Q2 conducting, the base of Q5 is pulled down more negative than its emitter sitting at around 6-6.5V. This causes Q5 to conduct and thereby discharges C5 via R7.

Component table for various amplifier power supply values

Input Voltage Range	1 Watt ZD2, ZD3	5 Watt WW R28, R29
60 — 70V	9V1, 9V1	1k,1k
52 — 60V	9V1,9V1	820,820
46 — 52V	9V1,9V1	680,680
40 — 46V	9V1,9V1	560,560
32 — 40V	8V2,8V2	390,390
15 — 32V	none	link

When the voltage of C5 and the base of Q6 drops below the zener voltage of ZD1 plus the B-E junction, Q6 drops out of conduction and deprives Q7 of base current thereby turning it off and denergising the relay.

Transistors Q3 and Q4 operate in a similar manner to that described above except that in this case, the input voltage to the B-E junction has to be more *positive* than 0.5V. With either Q3 or Q4 conducting, C5 is again discharged via R7.

In order that the detector circuit discriminates between the normal AC signals (audio signals) and very low frequency sub-audible (below 20Hz) or DC offset voltages, a low-pass filter has to be added. The filter networks R1/C1,R3/C3 and R2/C2,R4/C4 have a time constant that prevents the knee voltage on Q1-Q4 ever being reached for signal half-cycles of less than 50ms. The actual detection period is a function of the input voltage amplitude and the filter time constant with respect to the 0.5V threshold voltage. The higher the fault condition voltage, the faster the response of the detector. This is what you would hope to achieve. A higher fault voltage results in greater current through the speaker voice coil and as a result can inflict greater damage, so the faster the speaker is disconnected from this state the better.

After a fault condition is detected, the relay is held off for a period of 2-4 seconds by the discharged C5. This condition is similar to the power-up state. If the abnormal state still exists with any of Q1-Q4 transistors conducting, C5 will be held discharged – therefore depriving the output circuit of bias current; so the relay remains off. The 2-4 second hold-off period prevents relay chatter in the case where the input abnormal state is a very low frequency. This is another state that can damage a speaker system when the input power level is high enough.

Now let us look at the overload monitor section. This circuit uses an LM339 quad comparator as the basis of operation. Input voltage levels from 15V to 60V peak can be catered for by the adjustment of VR1 or VR2.

To detect both negative and positive voltage excursions in excess of the preset level on both channels, four comparators are used.

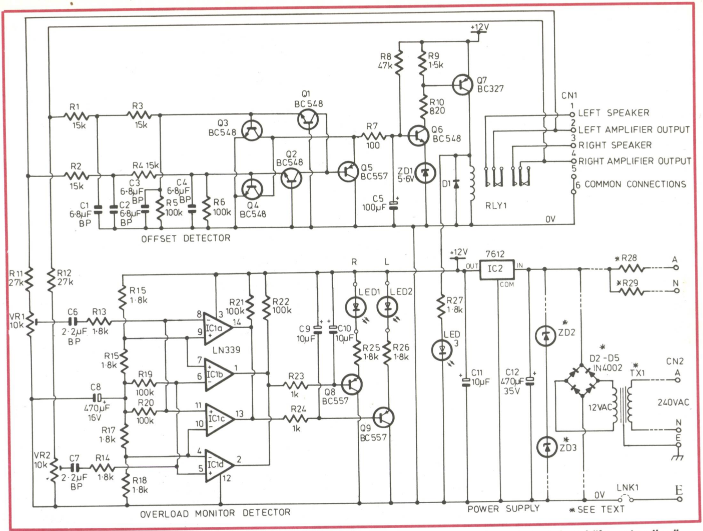
Two comparator reference levels are provided to sense both the positive and negative voltage swings about the common rail. This is achieved by tying one input of each comparator to a tap on a voltage divider (R15-R18) across the regulated 12V Vcc rail. The other inputs are tied to a common point at 1/2-Vcc (6V). With equal resistors in the R15-R18 divider chain, the reference values are 3V and 9V with respect to 0V. Or, another way of looking at it, plus or minus 3V above and below the common 1/2 Vcc point.

Because these comparator levels are with respect 1/2 Vcc and the input signal is with respect to 0V, AC coupling by C6,C7 is provided in order to allow the necessary level shift. Capacitor C8 provides AC decoupling between the two levels.

Sections a and b of the LM339 detect the positive excursions above the 3V reference point for each channel, while sections c and d detect the negative swings of greater than 3V.

The output stage of each comparator is the uncommitted collector a grounded NPN transistor requiring pull-up resistors (R21,R22). This allows a wired-OR state to combine the positive and negative detection signals from the two channels. When an overload excursion is detected, the output at either pins 14,1,13 or 2 goes low.

A positive overvoltage input on the right channel will cause pin 1 of section b to go low, for example. Capacitor C10 is now charged through R232. This voltage on the base of Q8 is "followed" at the emitter (less the B-E knee voltage) and turns on LD LD1 via current limit resistor R25. After the overvoltage on the input disappears, the output transistor in the b section comparator is turned off. The stored energy in C10



The complete circuit schematic, showing the alternative power supply arrangements for internal and "free standing" versions.

can now only be discharged via R23/R22 and the B-E junction of Q8. The current through the B-E junction is low due to the action of the emitter follower, so that the greater portion of the discharge current is through the resistors. This results in a slow discharge of C10, producing a fading out of LD1 over a period of 1 to 3 seconds.

Operation is very similar for a negative overvoltage peak, in either channel, which will cause LD2 to flash.

Power supply

With a fully self-contained system, power is derived from a small PC board mounted M-2851 transformer and full wave rectifier. In this case, R28,R29 resistors and zener diodes ZD2,ZD3 are not used. The raw DC from rectifier D2-D5 is supplied to 12 volt three-terminal regulator IC2. A small heatsink is provided on this IC to dissipate heat.

Where the system is to be connected to an existing amplifier's power supply, the transformer and rectifier diodes are left out.

It is worth noting at this point that this unit draws around 90mA and has to have a minimum supply voltage of not less than 15V. See the table for various supply voltages and the component changes. Some variation of the resistor values may be necessary to result in a potential of around 15V to the regulator when the relay is energised.

If there is any doubt about as to suitability of your amplifier's power supply to provide the necessary voltage, it would be advisable to use the standalone version with the transformer and rectifier components on board. In this case, all you have to do is connect the mains supply of the Monitor/Protector to the secondary side of the amplifier's mains power switch.

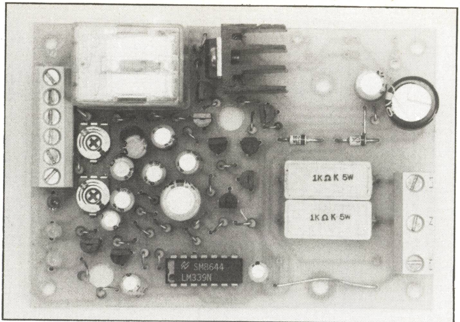
Construction

In order to keep the PC board down to a reasonable size so that it may be fitted internally to an amplifier, most components are mounted vertically to gain maximum use of available PC board real estate. The board has also been designed to fit the Dick Smith H-2503 plastic case.

Firstly, the components inserted around the power supply section will depend on how the PCB module is to be used. If it is to be a stand-alone system outside the case of an existing amplifier, the transformer and four rectifier diodes D2-D5 are installed. Fitted to an existing power supply, resistors R28,R29 and zener diodes ZD2, ZD3 are used in place of TX1, D2-D5. See the table and alternative overlay diagrams for details.

Preform all carbon resistors by bending one lead back along its own axis so that it becomes a single-ended component. Insert so that the body end sits on the PC board surface. Bend over the legs under the board to hold the component in place vertically. Insert all electros, noting those with polarity have specific orientation.

Then fit the transistors and diodes,



Top view of the internal version, a whisker larger than actual size. As shown below the external version uses the same PCB and is very similar except in the power supply area.

again noting orientation. Insert the trimpots, LM339 IC and the link LK2. Trim component leads and solder as necessary.

Now fit the regulator to the heatsink, with an M3 screw. Instal in position and solder. The heatsink mounting pins need quite a bit of heat, so be careful not to damage the board. Fit the relay, transformer and rectifier diodes. Cut the transformer leads short to suit the distance to the PC board connections.

Note that connector CN1 is advised with this setup.

The alternate 5W power resistors R28,R29 and zener diodes ZD2,ZD3 combination along with the link LK1 can be fitted as the option.

Setting up procedure

The DC offset detector does not require any setup or adjustment. Assuming that the construction is correct, this section should operate straight off. A quick test is to place a 1.5V battery or similar voltage source across the input terminals in both polarities on both channels. The relay should drop out with each condition along with the LED. This test should of course be done without any other external components connected.

Depending on its intended use, the setting up procedure for the monitor section can be simple or more involved if precise monitoring is required.

The point at which the amplifier's output signal reaches its maximum level and the peaks of the waveform start to flatten out is referred to as the *clipping point*. The onset of clipping in the output stage is where the power supply can no longer support the power level being demanded of it, or the output stage itself starts to limit for some reason.

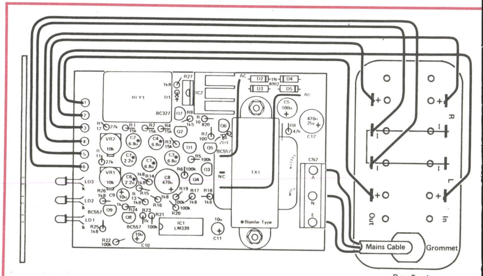
The only way of monitoring the condition is to use an oscilloscope to view the output waveform, so connect the Monitor/Protector to the amplifier/speaker system. If you have available suitable 8ohm dummy loads to replace the speakers (to save your ears), fit these.

Connect a sinewave generator to both inputs of the amplifier and the oscilloscope to one output. Set the audio generator to around 400Hz (or some frequency you can put up with if you have to listen to it) and increase the level until the sinewave at the output just starts to flatten out on the peaks. This is the clipping point. Adjust the monitor preset VR1 (or VR2) until the LED is at maximum brightness. Adjust VR2 (or VR1) similarly.

If you haven't an oscilloscope but have access to a sinewave generator, another but less accurate way of setting up the monitor is by listening tests. With the setup above, and the speakers connected, increase the signal level until the sinewave starts to sound harsh or "edgy". If this is not easy to detect, try changing the frequency to detect the change in sound. Assuming you can hear this point and your ears haven't fallen off or your neighbour battered down your front door, set VR1 and VR2 so that the LEDs come on to coincide with this point.

Without either of the above instruments, you can set the controls so the LEDs come on to indicate overload at a point where you consider the system starts to break down or sound bad, on normal music or speech program.

Another use for the monitor facility is to indicate a maximum usable power level for your amplifier. This could be used in a situation where the amplifier power output is greater than the speaker system's handling capability; or a maximum level for the kids to use when friends come to visit; or a maximum level for party music. In these



How the PCB is wired up and connected inside a small box, in the external "free standing" version. This uses its own small power transformer and bridge rectifier, on the PCB.

cases, simply set the monitor controls by listening to music or program material at the level you consider maximum.

With the input voltage dividers shown (R11,VR1 & R12,VR2), the minimum input voltage that the comparators will accept is around +/−12-13V (equivalent to around 8W into 8 ohm loads).

By reducing the value of R11 and R12, this input detection level can be reduced. Change R11 & R12 to 15k for 5W to 70W operation, or 8.2k for 2.5W to 30W.

If you intend to use the power supply of an existing amplifier as the source for the Monitor/Protector, firstly measure the voltage available at the positive rail. Note that the negative rail cannot be used in this application. From the table given, fit the necessary components to the PC board.

Decide on a suitable mounting position inside the amplifier case, connect the positive power rail.

Divert the wiring from the output stage to the speaker terminals, through the Monitor/Protector relay switching terminals. Wire the indicator LEDs to a suitable panel mounting position, insulating the LED lead connections as necessary.

Switch on the system to check operation. See the setup procedure for detail. Note that it may be necessary to change the values of R28,R29 slightly from those shown so that the voltage to the input of the regulator (across C12) is not less than 15V or greater than 18V with the relay energised.

It may be easier (and safer), if you are not sure of this power supply connection and suitability, to use the self powered system by including the transformer and rectifiers on-board. In this case, the mains supply to the protector circuit's transformer is taken from the secondary side of the amplifier's main power switch.

PARTS LIST

Resistors

(¼W 5% unless stated)

4	1.5k ¼W
2	100k
1	100Ω ¼W
1	47k ¼W
1	1.5k ¼W
1	820Ω ¼W
2	27k ¼W
6	1.8k
4	100k ¼W
2	1k ¼W
3	1.8k ¼W
2	5 Watt wire wound resistors (see text)
2	10k 10mm horizontal trimpots

Capacitors

4	6.8uF 50V bipolar
1	100uF 16V electrolytic
2	2.2uF 50V bipolars
1	470uF 16V electrolytic
3	10uF 25V electrolytics
1	470uF 35V or 50V

Semiconductors

1	LM339 quad comparator
1	7812 voltage regulator
1	1N4148 silicon diode
4	1N4002 PWR Diodes (see text)
1	1N752 5V6 400mm Zenner diode
2	1 watt zenner diodes (see text)
1	3mm oramer led
1	3mm red led
1	3mm green led
4	BC548 or BC547 transistors
1	BC557 Transistor
1	BC548 or BC547 transistor
1	BC327 Transistor
2	BC557

Miscellaneous

1	M-2851 12Vac/120 mt Transformer (see text)
1	12V Coil DPDT power relay
1	6-way PCB mount screw connector
1	3-way mains PCB screw connector
1	100 × 70mm printed circuit board.
1	case (optional – see text)
1	mains cable (see text)

screws, nuts, washers, copper wire, etc

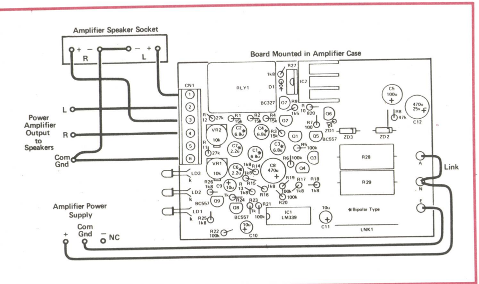
With this setup you need some form of housing. The board has been designed to fit the Dick Smith H-2503 plastic case. The connector block CN1 is not used in this case and the terminations are wired to terminal strips on the back panel. We used two of the Dick Smith H-6624 screw terminals. These along with a H-1724 cord clamp grommet for the mains cable made a tight but neat rear panel layout.

The three indicating LEDs LD1-3 can be soldered directly into the board and bent at right angles to penetrate the front panel. Needless to say this must have 3 x 3.175mm holes drilled in the appropriate position.

To get the board to fit neatly into the case, one of the small posts has to be cut from the front bottom RHS of the case (viewed from the front). In the top half, cut off the mounting boss nearest the centre and cut the shoulder off the corner brace that sits over the relay.

The wires from the amplifier speaker output terminals are connected to the input terminals of the Monitor/Protector. The output terminals are then connected to the speakers. The mains lead is connected to the same power switch as the amplifier. Remember to switch on the amplifier's own switch first.

If your amplifier has a switched AC output socket, connect the Monitor/Protector to this, to ensure correct operation.



The corresponding wiring arrangement for the internally mounted version, which uses power derived from the amplifier via series resistors and zener diodes.

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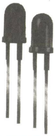

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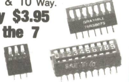

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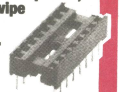

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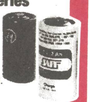

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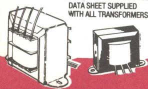

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Type 'F' 3" Round 16ohm 1W	2.50
Type 'G' 4"x2½" Oval 8ohm 1W	3.00
Type 'H' 3½" Round 8ohm 1W	3.00
Type 'I' 4" Square 8ohm 1.5W	3.50
Type 'J' 3½" Round 8ohm 0.8W	2.25
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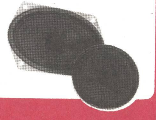

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Removed from Printers but in excellent condition. Has a lot of uses; the KEYS themselves are worth a little fortune.

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Normal Prices.

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Towers International Transistor Selector Data Book

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Oil-Less Diaphragm Vacuum Pump and Air Compressor.

Model No: DOA-V141-AA. Operating Voltage 115VAC 1 phase 60Hz. Pressure 85KPA. Complete with Operating & maintenance instructions. A First Class engineering Unit at almost a ¼ of the original price.

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Type 560-0002. Useful for timing, intergrating & Counting. Case is Silver, Anode is Gold. Incl. of Data sheet.

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Suitable for 3½ Digit Displays. Consists of Clear plastic front window, Inner display retainer and waterproof strips. Dimensions: 57 x 33 x 6mm. Aperature dim: 46x18mm.

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I.C. Sockets

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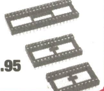

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Vacuum Fluorescent Displays by FUTABA

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$29.95 Inclusive of Post & Packing

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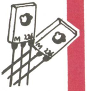

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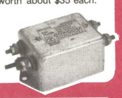

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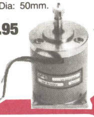

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WORTH TREBLE.

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* "FUJI" Stepper Motors Model: GPF-4915-1. J

Step Angle 1.8° Volts: D.C. 4.7. Amp D.C. 1 amp. Phase Insul. Class "B" Rating Cont. Dia: 55mm. Overall Length: 80mm. TREMENDOUS VALUE AT ONLY

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STK. NO: Z115

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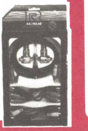
Fits all makes of Videos for recording between Sets



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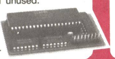

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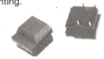

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2SK133 - 'N' Channel 2SK48 - 'P' Channel

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CROUZET Syncronous Motors

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WORTH TREBLE!!

STK. NO: Z131

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CAD software review:

CADMAX: Low cost CAD for IBM compatibles

At Last there's a computer-aided drafting package within the reach of the hobbyist. Developed in New Zealand, CADMAX provides all the features required to produce accurate PCB artwork for prototyping and production.

The CADMAX computer aided drafting package was developed in New Zealand at the Department of Scientific and Industrial Research, Southern Industrial Development Division (SIDD-DSIR). SIDD-DSIR is a research organization funded by the New Zealand government, and the package was developed to reduce the bottlenecks encountered in its in-house PCB design facility. The package was designed to take as much repetition out of PCB design as possible, while leaving the designer total freedom in design layout.

Rather than develop an automated design package around an auto-routing system, the approach taken was to develop a package to replace the "tape-and-donut" system, and avoid a lot of the repetitive tedium which that approach often involves – especially for complex digital boards. Unlike some CAD software (especially general purpose packages that require a lot of customisation before they are really usable), CADMAX is in constant use by the people who wrote it, and for the same task as end-users purchased it for. For this reason, if there is something which you need to do with it, chances are it can be done with a minimum of fuss.

CADMAX comes on a single MS-DOS 360K floppy disk. Contained on this disk are drivers for the three most common graphics cards used in IBM PCs and compatibles: the CGA (colour graphics adaptor), EGA (enhanced graphics adaptor) and the Hercules monochrome graphics display. An extensive array of component pad templates is contained in several library files included on this disk.

Getting started

The first consideration is the machine which is to become your CAD "engine". CADMAX will work on an IBM PC, XT or AT and compatibles. An AT is certainly desirable if you intend to work with medium to large sized boards, otherwise you will find yourself spending a lot of time waiting for something to happen. However an XT running at 4.77MHz was found to be quite adequate for smaller boards. In general, the faster the clock speed and the fewer the number of wait-states the better. If you are lucky enough to have a 386 based machine it'll really scream along!

Many CAD packages use floating-point arithmetic, and require an 8087 (or 80287) in order to achieve reasonable computational performance. This is great if you happen to want to resolve the time on somebody's watch in a model of the solar-system, but for most PCB work it amounts to overkill. Instead, CADMAX uses integer arithmetic which does not require the numeric co-processor, amounting to a considerable saving in hardware cost.

As already mentioned, the package supports all three common graphics adaptors in use on PC compatibles. The CGA mode is best described as "adequate". It provides a multilayer display, but the resolution is not really good enough for CAD work. It is possible to see how the board is arranged, but you will need to zoom in a fair bit to check out clearances on screen.

The Hercules board provides much better resolution, but the casualty of this is the multilayer facility. You can still edit multilayer boards, but you cannot display two or more on the screen simultaneously to get an overall view. In most cases this will not be a problem, and in any case would be unnecessary if you are only working with a single layer board.

The EGA card gives you the best of both worlds: a high resolution, multilayer display. SIDD-DSIR also has available a graphics toolkit for those who want to write their own drivers for higher resolution display boards.

CADMAX does not make use of any form of extended of expanded memory. However if this memory is present in the system it can be effectively utilised (with suitable drivers) as a printer buffer or RAM-disk. The usual volatility problems associated with RAM-disks of course need to be taken into consideration if you put your current work-file in the RAM-disk.

While the manual for the package is sold separately from the software, it is strongly recommended. Limited documentation is provided on the disk, but as with any complex piece of software, operation is made much easier through the use of the manual. This is especially true if you are totally new to CAD.

Two manuals are supplied with CADMAX (in addition to the on-disk documentation). The largest of the two is the Technical Reference, which contains a detailed description of all the commands, descriptions of the operation of the various parts of the program, solutions to common problems and much more.

The other manual is much easier going, providing a general introduction to the installation and operation of the package, including a walk-through example to get you started. Most users would start with this manual, keeping the technical reference on hand for when you start to get more adventurous.

The supplied library files save the designer from the task of designing basic items such as transistor and IC pads. However, you are not limited to these libraries, and if the pad pattern which you require is not included, the inbuilt editor can be used to generate components for your own libraries. This package makes no distinction between work files and library files. Therefore you can include an object from a previous work file simply by opening the relevant file as a library file, and placing the desired object in the new work file.

For example, if your current design requires, say, a bank of RAM chips, and you have previously used a similar layout in a previous design, you simply open the file containing the old design after opening your current work file and then any objects used in the old design are available for inclusion in your current project.

The only file which is modified during the course of editing is the work file. Other files opened after this one become library files, which are effectively read-only. These may be one or more of the libraries supplied with CADMAX, your own library file or a previous design as described above. Because of this reason, the editor which you use to design circuit boards can also create and modify library files.

Once familiarised with the package (which doesn't take an excessive amount of time), we found it relatively easy to use. Graphics and text are displayed on two separate windows, and the screen is toggled between these using the *End* key on the cursor keypad. As you get used to the commands you can enter them "blind", without switching to the text screen at all.

The command syntax is quite consistent, making blind operation quite feasible after only a short time with the package. A Microsoft mouse can also be used for menu selection, or if you have a suitable driver, you can get the mouse to emulate the cursor keys for line-drawing.

Output devices

This is all very fine, and looks really pretty on the display of the computer, but is of little practical value if you cannot turn the results into a finished PCB without too much trouble. This is one area in which the versatility of CADMAX really shines.

Either X-Y plotters or dot-matrix printers may be used to print out the design – either actual size, double size, or even greater. This effectively increases the resolution of your printer or plotter, provided you have facilities to reduce the size of the print-out back to actual size. Enlargements greater than 2:1 would not be used often, as the maximum board size diminishes rapidly (unless you have a very wide printer or plotter). Large enlargements *can* be useful for optimising new pad shapes, for example.

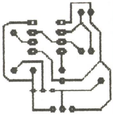
Note also that the range of compatible dot-matrix printers includes laser printers and the new crop of high-resolution ink jets. Laser printers are becoming more and more common as prices fall, and may be a viable alternative to an expensive plotter for those who also require high quality text output for desk-top publishing or word processing.

We tested the package with a laser printer emulating an HP Laserjet Plus, and a simple PCB pattern produced on this printer accompanies this review. This may be compared with the same board produced on an Epson LX-80, both actual size, and at 2:1 (photographically reduced back to actual size).

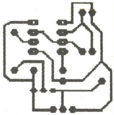
One very useful feature is the ability to direct the output to a file rather than an output port. If you have access to a laser printer, but it is connected to another computer, then all you have to do is to copy the print file onto a floppy disk, and use the DOS *copy* command to send the file byte-for-byte to the printer. Laser printer output files are extremely large, so this option should be used with caution on floppy based machines if you are producing a large drawing. The tiny example presented here occupied about 100K of disk space.

CADMAX can be obtained from SIDD-DSIR, P.O. Box 22-303 Christchurch, New Zealand. The complete runtime system, including component libraries, costs $50. The manual is an extra $200, and this includes registration for future updates. An additional surface-mount library disk costs $20. These prices are in either Australian or New Zealand dollars, whichever is most convenient. Also available, for those who want it, is linkable object code and complete source code. For prices, contact SIDD-DSIR direct. (M.C.)

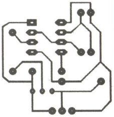
A simple board printed actual size with a 9 pin dot-matrix printer.



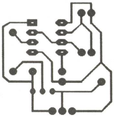
The same board and printer, but using the "HQ" printer driver.



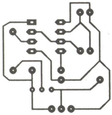
The same printer, but printed double sized and photographically reduced back to actual size.



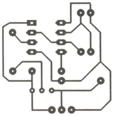
Again, a reduced double sized print-out, but with the "HQ" driver.



This is an actual sized reproduction of the same board from a 300 dot per inch laser printer.



The same laser printer as above, but printed double sized and reduced, giving an effective resolution of 600dpi!



NEW KITS THIS MONTH!

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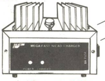
Move over, Musicolour: the Disco Light is here! An incredible array of spectacular lighting functions is at your fingertips with this new design from Silicon Chip. Features 4 channels with sound to light, chasing, beat chasing, strobing, beat strobing, reverse, forward, up, down, sideways . . . you name it, your lights will do it! Cat K-3150



SC

$45

Megafast Nicad Charger

If you race cars or boats, you'll know what a hassle charging the 7.2V NiCad is. And you'll probably also know (to your cost) that most chargers aren't worth a cup of cold tea! Silicon Chip's new 7.2V NiCad Charger has two different cut-off methods to prevent overcharge - but will still charge a dead flat NiCad in around 15 to 20 minutes. Beaudy! Cat K-3477

Speaker Protector

That "thump" you get when you turn your amplifier on is more than annoying: it's dangerous! You could end up blowing the cones from your speakers - and possibly damaging the amp as well. Protect your investment with this kit: it's easy to build, and stops that massive overload hitting your speakers. You'll find it in this month's Electronics Australia, Cat K-4008

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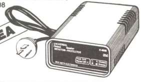

AEM

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Tilt Alarm

Talk about novel: a go-anywhere alarm which will sound when it's tilted. Think of the applications: theft alarms for bikes, golf clubs, . . . anything; even stops people tilting back on chairs! New this month from Australian Electronics Monthly. Cat K-3248

Strobo Tuner

Tuning forks are passé! With this new tuning aid from Electronics Australia you'll be able to accurately and professionally tune musical intruments in seconds. It's fully self contained and is quite an easy kit to build. If you're into music - get into this! Cat K-3550

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PARTS DELAYED: AVAILABLE SOON

Line Filter/ Conditioner

EA

Here's one for the computer buffs, especially (but it also suits hi-fi & countless other applications) Elcom is supposed to sell you 240V, 50Hz. Unfortunately, they also give you all sorts of spikes, spruigles and shrdlupp on the line (not to mention the clicks and plops you make yourself!). Clean up dirty power lines with this new line filter/condition from Electronics Australia. Fred Nile would be proud of it! Cat K-3080

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Want to build a Crystal Set?

Like the one in this month's EA? Sorry - we cannot supply that kit (the tuning capacitor is almost impossible to obtain!) But we can help you with a kit for a crystal set! Did you know that in Fun Way Into Electronics there's a crystal set to build - along with 19 other great projects - including the famous Beer Powered Radio! Get into Electronics the Fun Way!

Fun Way Into Electronics Gift Box (Fun Way Vol 1 plus 20 projects to build). Cat K-2605

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Controls virtually any 240V device with on/off control. Just the shot for those cold winter nights: turn the telly off without getting out of bed! Cat K-3428

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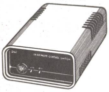

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When it's a modulator kit. RF modulator is pre-built and tested, ready to add to that project you've been waiting to build. Cat K-6043

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Why buy a new tuner when you can add this AM stereo decoder to your present tuner and get full AM stereo? And look at the saving . . .
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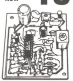
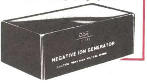


Nothing negative about this one! Near ½ Price Neg Ion Generator

What a saving! And what a kit! Build your own negative ion generator: find out for yourself if the fantastic claims are true! Price includes safe, low voltage plug - pack. Cat K-3333

WAS $49 NOW **$24.95**



Check your Microwave!

Is it safe? Does it leak dangerous microwaves? This great little kittle tellya! Cat K-3095

WAS $17.45 NOW JUST **$12.95**

Why build a radio?

Just for the fun of it! Build yourself a great performing little AM Headphone Radio. And this month you'll save $2.00! Cat K-2720

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TV Cro Adaptor

Turn that old b&w (or colour if you're affluent) TV into a great audio oscilloscope with this nifty kit. Up to 300kHz bandwidth - so its great for audio! Cat K-3060

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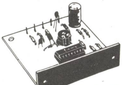
Add this to your hi fi for a mini lightshow! It's useful, too - peak level display can warn of danger! Cat K-3370



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LOOK FOR THE GREAT NEW KIT KOMPETITION ELSEWHERE IN THIS ISSUE.
DICK SMITH ELECTRONICS: NO 1. FOR KITS!

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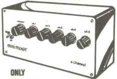
WINTER: A GREAT TIME TO BUILD A KIT AND $AVE!

AEM's new Mini Mixer



Fantastic! A 4 input audio mixer for the amateur with specs good enough for the pro! Use it for mixing various audio sources - mics, tapes, guitars, organs, etc etc. Easy to build, easy on the pocket! Cat K-3039

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High performing modules for use in PA, band amps, even good enough for hi fi use! And they're $$ cheaper than last year!

60 Watt Mosfet

Easy to build module with everything on one pcb. Easy to get going - and easy on the ear! Easy kit from AEM. CatK-3441

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120 Watt Mosfet

Similar to amp at left, but this one packs a massive 120 watts of muscle. Just add an appropriate power supply and GO! Cat K-3443

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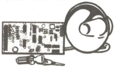
It's Alarming!

Light fingered louts are lifting lots of lovely loot. Stop 'em in their tracks with these alarm kits!

Car Alarm



The deluxe job from EA. Everything you could want to protect your car - and then some! Cat K-3252

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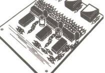

3 digit counter with driving circuitry to do . . . whatever! Comprehensive manual included. Cat K-3451

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No, we're not selling kits to make VCR's! (Hey! That's a good idea. R&D — get cracking . . .) These kits will add enjoyment to your videoing.

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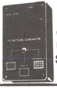

What's this got to do with VCR's? Not much - but if TV repair is your game, then this one's for you. Dot, crosshatch and blank raster. And yes, you save! Cat K-3472

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40 metre upgrade kit for above transceiver. Cat K-6332 WAS $39.95 NOW **$19.95**

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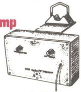
GaAsFET Masthead Preamp for 70cm reduced, too



13dB gain with around 1.5dB noise: nice! Complete kit includes all mounting hardware for mast top. Pull in signals you didn't know existed! Cat K-6309

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Cut through the noise - and get at least 100W out with 10W drive! 13.8V DC operated - so it's just as much at home mobile! Cat K-6313

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Too MUCH signal your problem? RF Attenuator will solve it. And you'll solve the $10 saving. Cat K-6323

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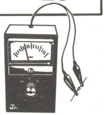

Great for when the value's rubbed off - or your eyesight can't distinguish those damn tiny numbers! Cat K-3051

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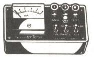

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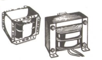

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COMPLETE WITH CIRCUIT

Simple construction project:

Line filter & 'conditioner'

Does your computer spontaneously reset whenever the people next door turn on their vacuum cleaner or lawn edger? Does your hifi system emit a loud 'click' whenever the fridge compressor turns on or off? Here's an important tool for tackling both kinds of problem: an easy to build line filter and pulse clipper. You can build it for far less than commercial units.

by ANDREW PALMER

Whenever the current in an electrical circuit is turned on or off, noise pulses or "spikes" tend to be produced due to energy storage in the circuit's inductance and capacitance. The higher the current and voltage being switched, the higher the energy in these spikes – and the more potential for them to cause trouble by finding their way into other, sensitive equipment.

Needless to say, a prime cause of this kind of trouble is equipment with electric motors, and operating from either 240V or 415V power. Even small electric motors can draw quite significant "inrush" current when turned on, and with a fair amount of winding inductance they also produce a strong inductive "kick" when turned off.

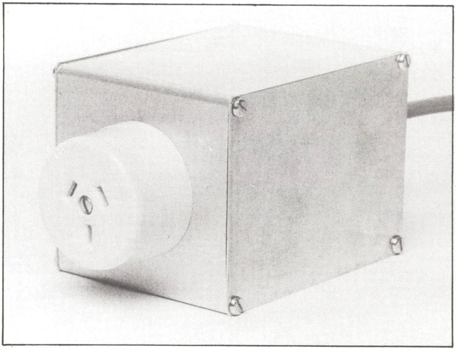
Although some modern electrical equipment is fitted with suppression circuitry to reduce the level of these spikes, there is still a lot of gear that generates them all too efficiently. This hasn't been helped much by the trend towards double-insulated tools and appliances, either, as double insulation tends to reduce the efficiency of most spike suppression techniques. Some of the worst offending appliances are thus electric drills and saws, food mixers, vacuum cleaners, lawn edgers and similar motorised appliances – with things like fridges and freezers often not far behind.

With so many pieces of equipment being turned on and off all the time in a typical city or suburban environment, there's a potential "hailstorm" of noise or *electromagnetic interference* (EMI) being generated, almost continuously. Some of this is radiated directly into the air, to add to the overall level of atmospheric electrical noise, while the rest is propagated along the mains wiring.

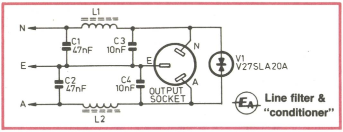
Airborne EMI mainly affects radio and TV reception, causing static and bursts of "snow" on your TV screen. But the EMI which travels along the mains wiring can find its way into all sorts of sensitive equipment like your hifi system, where it will cause those annoying "clicks" or "plops" or worse (like buzz-saw sounds) right in the middle of your favourite Beethoven piano sonata. Or it can get into your personal computer, and cause it to "crash" or reset in the middle of a program or word-processing session – half an hour since you last remembered to save your file on disk!

Luckily quite a few modern personal computers are provided with internal mains filtering circuitry, to make them less subject to this sort of problem. But there's still a lot that aren't, just as there are a lot of hifi systems that have no internal protection against mains interference.

The line filter and "conditioner" project described in this article is designed to help in these situations. It provides a high degree of EMI filtering, together



The author housed his prototype filter inside a small extruded aluminium utility box, the H-2420 from Dick Smith Electronics.



Line filter & "conditioner"

with the ability to "clip" large spikes which force their way through the filtering and could otherwise still cause interference and/or damage.

And the good news is that you'll be able to build the unit for less than $45 – less than one-third the current cost of comparable mains filters and conditioners. So it's an ideal subject for a build-it-yourself project, especially as it's also very easy to build.

By the way, it won't necessarily be a complete solution to all of your EMI problems. It can't stop airborne interference, for which other techniques are needed. Nor is it capable of filtering out or clipping ALL mains-borne interference; no simple device can. But it *will* knock the spikes and noise down quite a long way, in most cases.

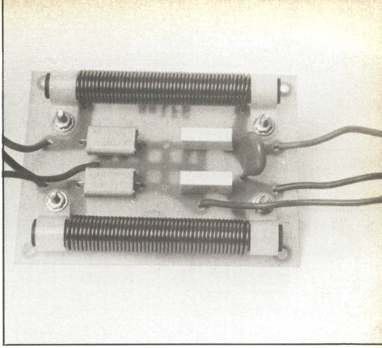
Of course the best place to tackle electrical noise is really at its source, rather than at the "receiving end". However you can't always do this, either because the offending appliance belongs to somebody else, or because fixing the problem would involve major "surgery" inside the appliance. So a simple line filter at the receiving end may be the most practical answer, especially if it solves the problem.

Circuit details

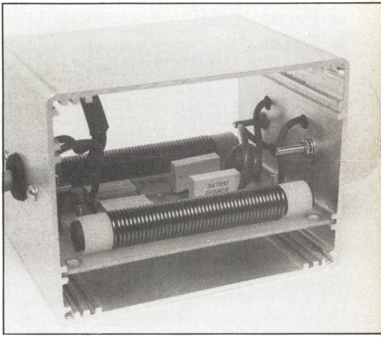
As you can see, there isn't much in it. Simply what's known as a *pi-section* LC filter network, with a series inductor and two shunt capacitors, in each of the main power leads (active and neutral). The capacitors connect to mains earth, in each case.

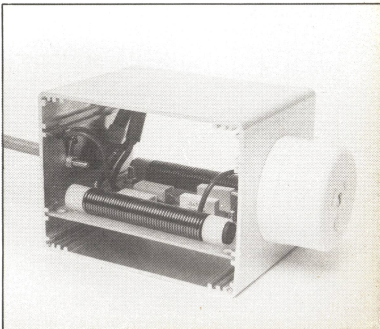
Inductors L1 and L2 are each wound on an 82mm length of 9mm-diameter

As you can see from the schematic above, there are very few parts in the filter circuit.



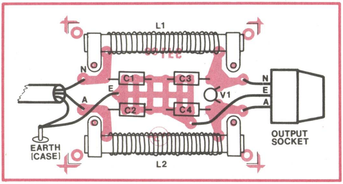
Right: A view of the assembled PCB before it was fitted inside the case. The board takes most available types of capacitors rated at 240V AC.





Right and lower right: Two views of the inside of the filter when assembled, showing how it goes together. Note the lug to earth the metal case.

Below: Use this overlay diagram as a guide to wiring everything up.



ferrite rod. Each coil consists of 45-1/2 turns of 16 gauge (1.34mm) enamelled copper wire. Capacitors C1-C4 are all 47nF high voltage polycarbonate types, rated to operate at 240V AC.

In addition to this basic EMI filtering, there's also a *varistor* device (V275LA20A) connected across the filter output socket, directly between active and neutral.

The varistor is a non-linear resistor, which is virtually an open circuit for the normal 240V AC waveform. But when a high voltage "spike" blasts its way through the filters, superimposed on the 240V wave, the varistor suddenly conducts current. This allows it to absorb the energy in the spike, effectively clipping it to a voltage only a little above the normal 240V level. As a result, it is prevented from causing much trouble.

Construction

To ensure that its filter inductors don't radiate any of the interference they block, the line filter's circuitry must be housed in an earthed metal case. This should also be sturdy, to prevent breakage and exposure of live wiring should the unit be dropped on the floor or whatever.

As you can see from the photographs, I built the original in a new and fairly reasonably priced case being sold by Dick Smith Electronics (Cat. No. H-2420). Based on a section of aluminium extrusion with two flat sheets screwing to the sides, it assembles to make quite a sturdy case measuring 102×76×76mm.

To make the filter easy to assemble, and also make it as safe as possible when assembled inside the case, I have designed a small PC board to mount all of the "live" parts. This measures 98×74mm, and is coded 88LF6.

The size of the PCB is arranged to fit neatly in one of the slots of the H-2420 case, as you can see from the photos. This simplifies assembly, automatically keeping the live components and wiring away from the earthed case – without insulating spacers.

However in case readers may wish to use other cases, I have also provided the PCB with 3mm holes in each corner, to allow the use of insulating spacers in the usual way. By the way, the width of the PCB has been arranged so that it will also fit inside the small cast aluminium case measuring 150×80×50mm, and made by the Australian Transistor Company in Melbourne. This case is sold by a number of suppliers, including again DSE (Cat. No. H-2206).

The filter inductors are each fastened to the PCB using a pair of 9mm (3/8″) nylon cable clamps, with one at each end of the ferrite rods. The space between the clamps is about 60mm, enough to comfortably fit a winding of 45-1/2 turns in 16G enamelled copper wire.

High-voltage polycarbonate capacitors of 47nF/250VAC rating are made in a number of different physical sizes. Those I bought were of two different sizes, for example, as you can see from the picture of the assembled PCB, while others I had in my junk box were a different size again. So I've designed the PCB to cope with all three sizes, with multiple sets of holes for the "earthy" leads of all four capacitors. These provide for leads spaced on 10, 15 and 22.5mm centres, which I hope will allow you to use almost *any* brand of capacitor – barring the operation of Mr Murphy's law!

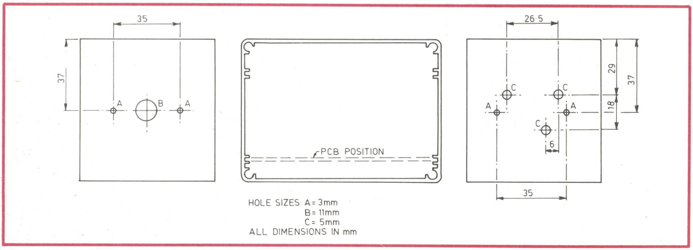
The construction of the filter should be fairly clear from the PCB overlay/-wiring diagram and the internal photographs, I hope.

I suggest that you start by making the two inductors. The first step is to prepare the ferrite rod – this comes as a single length about 195mm long, from which you have to make two lengths 82mm long.

This is actually quite easy, as ferrite rod is very brittle and will snap like glass rod. All you have to do is make a small nick in the rod with a triangular file, at the correct length, and then grip it firmly in both hands with your thumbs facing each other on either side of the nick, but on the far side of the rod (Fig.1). Then apply gentle pressure, and the rod will snap cleanly at the nick. All you have to do then is smooth the broken ends with a file, so you won't cut yourself later.

The two inductor windings can be wound directly on the ferrite rods, or on a length of 9mm (3/8″) scrap steel rod if you don't want to risk breaking the ferrite. You'll need about 1500mm of 16G enamelled copper wire for each one.

I like to stretch the copper wire slightly first, before winding it. This straightens it out nicely, and gives a neater result. So to do this for this project I cut off about 1700mm, and clamped one end of it in the bench vyce. Then I gripped the other end with stout pliers, and carefully pulled it until the wire stretched slightly and became really straight. Then without letting it go, I took the rod and carefully wound the wire on it, starting from the free end and gradually walking towards the vyce. Doing it this way only takes a few



Mechanical and hole drilling details for the case used by the author to house the filter.

minutes, but gives a very professional looking coil.

After winding the coils, bend them carefully so the ends will go through the holes in the PCB. Then cut them so they will protrude about 4mm through the board, and carefully scrape off the insulating enamel so they'll solder properly. Then you can mount the two inductors to the PCB, using a nylon clamp at each end. I suggest you fit the clamp screws from the underside of the board, with the washers and nuts above the clamps as shown. This will avoid any risk of the washers or nuts coming too near the "live" PCB conductors, and perhaps becoming live themselves.

Finally you can solder the two ends of each coil to the PCB pattern, after carefully bending it over on the copper side to ensure a good joint.

The capacitors can now be fitted, selecting the appropriate holes in the PCB to suit their length. The capacitors are not polarised, so it doesn't matter which way round you fit them – but just make sure you fit them between active or neutral and earth, not between a pair of earth holes!

Finally you can fit the varistor, V1. This is again not polarised, so it can go in either way.

Before fitting the assembled PCB into the case, I suggest that you cut about 70mm off the end of the mains cord, and open this to obtain the three short lengths of insulated mains wire. Then remove about 6mm of insulation from each end of these, and solder one end of each to the "output" pads of the PCB. Use the blue wire for neutral, the brown wire for active and the green and yellow striped wire for earth. These wires will ultimately go to the output socket, of course.

Now I suggest that you prepare the metal case, by drilling the various holes for the output socket, the input mains cable and the screws for the cable clamp and earthing lug. The position and size of these holes are shown in Fig.2. The large cable hole can be drilled smaller, and then enlarged out to size with a tapered reamer.

It would be a good idea to lightly countersink the clearance holes for the three wires for the output socket, to remove any drilling burrs and prevent the insulation being cut. The same applies to the large cable hole, to protect the grommet from damage.

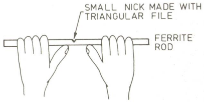
After cutting all of the holes, I fitted the grommet to the large cable hole and then passed the cable through it a fair way (say 250mm). Then I stripped back the outer sheath of the cable by about 50mm, and stripped about 6mm from the insulation of the three individual wires. This allowed me to solder the active and neutral wires to the PCB, with the latter still outside the case. It also allowed me to solder the earth wire to a solder lug, along with another 60mm length of similar wire – to run to the earth input of the PCB.

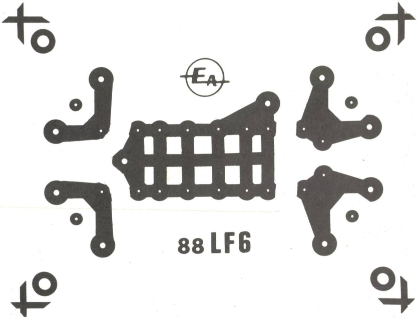
With the connections all completed, I was then able to slip the PCB into the slots of the case, and gently pull back the cable through the grommet.

The final steps were to attach the earthing lug to the case, using a screw, lock washer and nut (1/8", 3mm or 4BA), and the nylon cable clamp (6mm) used to anchor the cable itself. You can see from the picture how these should look when assembled.

If you follow this same procedure, you should find that it all goes together very easily. Then it's simply a matter of screwing on the two sides of the case, and your line filter and "conditioner" will be complete and ready for use. ⒺⒶ

Fig.1: How to break a long piece of ferrite rod into the smaller lengths used for this project. File a small nick, and then apply pressure as shown. The rod will break cleanly, like glass.





The PCB pattern for the liner filter, shown actual size.

Parts List

1	PCB, 98 x 74mm, code 88LF6
1	Metal case, 102×76×76mm (see text)
1	3-pin mains socket, round surface-mount type
1	Ferrite rod, 9mm diameter × 195mm long
1	Varistor, V275LA20A
4	47nF/250VAC polycarbonate capacitors
1	3-core mains cord (2m)
1	3-pin mains plug
4	9mm nylon cable clamps
1	6mm nylon cable clamp
1	Solder lug, 3mm hole
7	3mm (1/8") × 13mm screws with washers, lock washers and nuts
1	3.5 metre length of 16G enamelled copper wire
1	Rubber grommet, 15mm outside diameter

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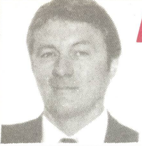

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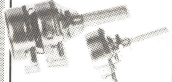

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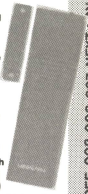
Mini Alarm



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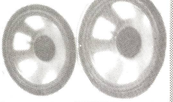

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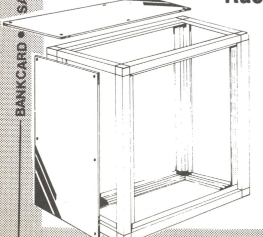

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(2) Complete Equipment Cabinet with the simple addition of the panel sets you now have a series of professional equipment cabinets of appearance and ruggedness second to non - and just look at the savings!

Side and Top Panels Tough power coat medium grey gives a pleasing contrast with the natural anodised frame. The resultant product is extremely professional in appearance and well and truly strong enough for the heaviest of electronic equipment.

6 Unit (370mm H) **18 Unit** (907mm) **30 Unit** (1450mm) **and 38 Unit** (1804mm) **Racks Available — All 450mm Deep**

	Normally	Now		Normally	Now
H 0365 Rack Frame 6 unit (370MM)	$ 99.50	$ 85.00	H 0382 Panel Set for H 0380	$149.00	$119.00
H 0367 Panel Set for H 0365	49.00	39.00	H 0385 Rack screw M6 PK12 Natural	2.95	2.00
H 0370 Rack Frame 18 unit (907MM)	129.50	99.00	H 0386 Rack screw M6 PK100 Natural	19.95	17.00
H 0372 Panel Set for H 0370	89.00	79.00	H 0390 Rack screw M6 PK12 Black	2.95	2.00
H 0375 Rack Frame 30 unit (1450MM)	169.95	149.00	H 0391 Rack screw M6 PK100 Black	19.95	17.00
H 0377 Panel Set for H 0375	129.00	99.00	H 0395 Rack captive nuts M6 PK12	3.95	3.00
H 0380 Rack Frame 38 unit (1804MM)	199.95	175.00	H 0396 Rack captive nut M6 PK100	28.50	25.00

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Great Value At $139 - This Month Only $119

Micron Electronic Temperature Controlled Temperature Selectable Soldering Station

T 2440

The MICRON T 2440 soldering station offers the ultimate in controlled temperature hand soldering 320 deg.C 350 deg. C 380 deg.C, 410 deg. C. (608 deg. F. 662 deg.F, 716 deg.F, 770 deg. F and 824 deg.F) Fixed temperatures are selectable by rotating the detained rotary switch freely without changing heater or tip.

Temperature Readout via lead baragraph instantly visable. **Patented Heating Element.** The specially insulated NICHROME wire heating element is compressed between two layers of stainless steel for ruggednes and is located at the end of the barrel to insure instant heat.

Temperature Readout via lead bargraph instantly visable. **Patented Heating Element. Heat Capacity.** Full 48 watts of het energy available for heavy duty work. **Zero Voltage Switching** The revolutionary electronic "Zero Voltage" switching, protects voltage and current sensitive devices such as CMOS against transient voltage spikes caused in stations. **Grounded Tip.** The soldering tip is grounded through the power unit to ensure the tip leakage is less than 0.4 millivolt or 0.03 microampere. **Low Voltage Element.**24V. **Chrome Plated Iron Plated Tip.**

Professional Soldering Iron Temperature Adjustable 250 deg. C to 450 deg. C

T 2445 $32.00

Excellent iron, screwdriver temperature adjustable between 250 deg.C and 450 deg.C enabling very delicate soldering on low settings with surprising heat energy reserve on maximum setting.

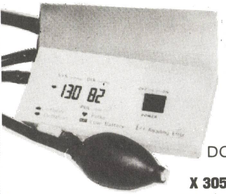
Relative temperature is indicated by LED lamp brightness. Much lower cost than a soldering station.

Normally $39.50

Why Risk Unnecessary Heart Attack?

Heart disease strikes down many people in their early 40's (or even 30's). The tragedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health.

Blood Pressure and Heart Rate Monitor



Features:

- Non-Microphone Measurement System
- LCD Readout
- Blood Pressure Monitor
- Pulse Rate Monitor

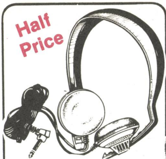
New Model

DON'T PAY ~~$150~~

X 3055 $99.00

Monitoring the cardiovascular system of every member of your family is now an easy and affordable necessity with the X 3055 Digital Blood Pressure Monitor. A built-in microcomputer and the microphone-free measurement system guarantee that all readings are highly accurate.

Half Price



Exhilarating Sound Performance

Brilliant Digital Headphones

Incredibly Comfortable

• Utilizes newly developed flat disk vibrator copper clad aluminium wire voice coil and somarium cobalt Magnet. The resultant reproduction is outstanding • Impedance 45 Ohms • Maximum input 400 mW • Frequency Response 20Hz to 20KHz.

C 9010 $19.50

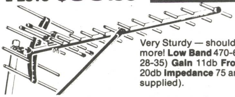
High Quality UHF 14 Element YAGI

Less Than 1/2 Price!

These high grade Yagi Antennas are from DX Antenna Co of Japan and originally sold for over $70!

We bought up an entire import shipment at distress stock rates & hence the fantastic savings to you.

L 2013 $30.00



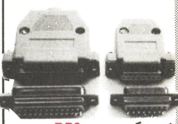
Very Sturdy — should last for 20 years or more! **Low Band** 470-610MHz. (TV Chan. 28-35) **Gain** 11db **Front to Back Ratio** 20db **Impedance** 75 and 300 Ohm (Balun supplied).

Save Up To 50% On Top Quality D Series Connectors!

Fantastic Value

D Series Computer Connectors. Gold Plated Professional Series

Items Marked • are 1/2 Price or Less



DB9

		WERE	NOW
P 3000	Male 9 Pin	2.95	1.47•
P 3010	Female 9 Pin	3.25	1.60•
P 3020	Male PCB Rt/L	3.75	3.00
P 3030	Fmale PCB Rt/L	4.50	3.50
P 3040	Male PCB mnt.	2.95	2.50
P 3050	Fmale PCB mnt.	3.95	2.25
P 3090	Backshell cover	1.95	.95

DB15

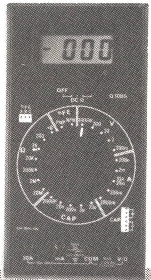
P 3100	Male 15 Pin	3.25	1.60•
P 3110	Fmale 15 Pin	3.85	1.90•
P 3120	Male PCB Rt/L	4.35	2.10•
P 3130	Fmale PCB Rt/L	5.50	2.70•
P 3140	Male PCB mnt.	3.85	1.90•
P 3150	Fmale PCB	4.85	2.40•
P 3190	Backshell cover	2.20	1.00•

DB25

P 3200	Male 25 Pin	4.95	2.47•
P 3210	Fmale 25 Pin	5.50	2.74•
P 3220	Male PCB Rt/L	4.95	3.50
P 3230	Fmale PCB Rt/L	6.90	3.90
P 3240	Male PCB mnt.	4.95	3.00
P 3250	Fmale PCB mnt.	6.25	3.95
P 3290	Backshell cover	2.20	1.10•

Digital Multimeter With Built-In Capacitance Meter

Not only do you get all the normal ranges of current, resistance and voltage - but also a convenient and simple to use capacitance meter in five ranges. And as if that's not enough, you also get a transistor tester. Check the features of this top quality new addition to the labtech range.



General:

Display: 3½ digit LCD, 0.5" height, with polarity & L0-BAT indication. **Overrange Indication:** 3 least significant digits blanked. **Maximum common Mode Voltage:** 500V peak. **Operating Environment** 0 deg to 50 deg. C; less than relative humidity from 35 deg C to 50 deg. C **Power:** 9V alkaline or carbon-zinc battery. **Battery Indicator:** Display indicates "L0-BAT" when less than 20% of life remains. **Dimensions, Weight** 170mm x 87mm x 42mm, 350grams.

SAVE $20

Q 1085 $119.00

Carry Case

Q 1086 $12.50

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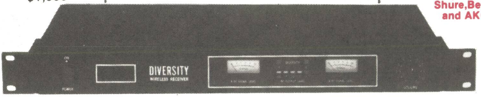
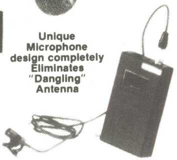
Superb *Redford* Wireless Microphone System Uses Dual Diversity Receivers for long Range, Noise Free Pure Fidelity Reproduction.

Now Available In Australia For Less Than $1,000

*Altronics proudly release the **Redford** Dual Diversity System - Used Worldwide by Entertainers i.e. Rolling Stones, Dire Straites, Tina Turner and 1000's more'*

Superb Microphone Reproduction Compares with Shure,Beyer and AKG





Unique Microphone design completely Eliminates "Dangling" Antenna

Breathtaking performance without signal drop-out or noise interference. The Eleco Wireless Microphone System is virtually the ultimate in an Entertainers Microphone system (or for any roving microphone application for that matter!)
All the annoying wireless microphone characteristics such as "drop out", static and noise are completely eliminated by use of **auto switching dual diversity receivers.** The output of each receiver is continually monitored, with the strongest and clearest signal always selected. **Dynamic Range exceeding 100 db** is obtained by employment of a Patented special Parabola level compressor and Dynamic expander.

The operating range is a minimum of 50 metres (often this can be extended to 200 metres and more in normal circumstances).

Several Frequencies are available to aleviate cross interference when two or more systems are used in proximity.

Brief Specifications Frequency 202.1, 202.5, 203.7MHz (Please specify if you have a preference)

Mic Carrier Power 50mW (Max) **Mic Antenna** built-in **Dynamic Range** over 100db **S/N Ratio** better than 90db **Frequency Response** 20Hz to 16KHz + or - 3db **Mic Battery** 4 x AA cells **Battery Life** over 24 hours continuous operation. **Receiver Sensitivity** 12db/micro volt for 60db S/N ratio **Pre emphasis/De emphasis** 50us. **Receiver output** unbalanced 6.3mm phone jack and balanced 3 pin cannon type. **Output Level** (adjustable) Unbalanced 0-2.5V Balanced O to + or - .3V into 600 ohms. **Receiver Power Supply** 200 - 260VAC.

Prices

(A)	Dual Diversity Receiver	**$729.00**
(B)	Entertainment Microphone (hand held type)	**$349.00**
(C)	Lavalier Type Microphone	**$349.00**

Bonus Offer SAVE $78 Choose Receiver and Either Microphone For Just $999

Please Note 3 different operating frequencies are available (you will need to specifically nominate desired frequency only if the equipment is being used in proximity with other Systems on the 200MHz band.

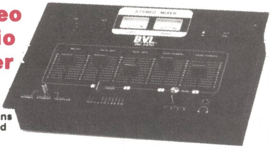
Frequencies

C 0111	Dual Diversity Receiver	202.1MHz	**$729**
C 0113	Dual Diversity Receiver	202.5MHz	**$729**
C 0115	Dual Diversity Receiver	203.7MHz	**$729**
C 0121	Entertainment Microphone	202.1MHz	**$349**
C 0123	Entertainment Microphone	202.5MHz	**$349**
C 0131	Lavalier Microphone	202.1MHz	**$349**
C 0133	Lavalier Microphone	202.5MHz	**$349**
C 0135	Lavalier Microphone	203.7MHz	**$349**

Stereo Mixers At Low Import Prices

ATTENTION: Social Clubs, Schools, Churchs, Disco Operators, Entertainers, Hotels, Night Clubs and Sporting Bodies. With Altronics low prices - here is your opportunity to install one of these outstanding sound control mixers. Both models iclude microphone "Soundover" facility - making either ideal for live entertainment use.

Stereo Audio Mixer



240V Mains Operated

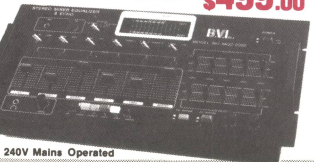
A 2550 **$199.00**

This brilliant little mixing console is absolutely packed with features. Allows blending of Microphone, two Phono inputs and either two Tape or Turner inputs • Right and left VU meters • Separate Bass and Treble controls • 5 slide level controls • Fader control between Phono pickups for professional cueing • Headphone monitor switch • Talkover facility.

SPECIFICATIONS:
• **Input** Mic 0.5mV 600 Ohms Phono 3mV 50K Ohms Tape/Tuner 150mV 100K Ohms • **Output** 250mV •**Frequency Response** 20Hz to 20Hz (plus or minus 1db) • **Tone Control (Treble)** 10KHz (plus or minus 12db) • **Tone Control (Bass)** 100Hz (plus or minus 12db) • **Distortion** Less than 0.07% • **S/N Ratio** More than 60db • **Headphone Impedance** 4—6 Ohms • **Dimensions** 318 (L) x 217 (W) x 85 (H)

Pro-Quality Stereo Console

A 2570 **$499.00**



240V Mains Operated

AMAZING VALUE

Our sophisticated 'NEW' Audio Mixing Console is ideal for 'live' recording • PA mixing • Fantastic Tape recordings • Even Stereo/Mono VCR recording. A truly professional deck that features separate R/L 5 band graphic equalisers • Echo and Peak LED level indicators • Talkover facility • Separate H/Phone level control • Patch switch bank • Individual microphone, Phono 1 Phone 2, Aux/Line 1, Aux/Line 2, and Master slide level controls. — Blend up to two magnetic or crystal turntables, two tape decks or tuners and two microphones all at once!!

SPECIFICATIONS:
• **Input** Mic 1—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms (low imp.) 2.5mV 10K Ohms (low imp.) Phono 1 & 2 (Mag) 3mV 50K Ohms Phone 1 & 2 (Cry) 150mV 100K Ohms Tape/Tuner 1 & 2 150mV 100K Ohms • **Equaliser** 5 frequency bands—60Hz, 250Hz, 1KHz, 4KHz, 12KHz—Boost Cut range-plus or minus 12db @ Centre frequency. • **Output** 1.5V/0.775V (Selectable) • **Frequency Response** 20Hz to 20KHz plus or minus 1db • **Distortion** Less than 0.05% • **S/N Ratio** More than 50db

• **Headphone Impedance** 4—16 Ohms • **Echo** B.B.D.System • **Delay Time** 30—200mS • **Echo Repeat Control** • **Delay Time Control** • **Dimensions** 480 (L) x 240 (W) x 110 (H)

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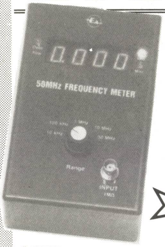
Altronics Kits Cost More

(A Dollar Or So More!)

There are some quite valid reasons of course. Such as fully punched chassis and hardware. Beautifully screened faceplates and panels. Prototypes built, tested and proven in our lab. Easy to follow instructions **and** free helpfull advice is just a phone call away if you should ever need it.



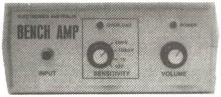
50MHz Low Cost Frequency Meter

(EA May'88)

Fantastic 50MHz Frequency Meter For The Work Bench & Tool Box For Less Than $100!

Inexpensive 4 digit 50MHz frequency counter offering high sensitivity and input impedance. Simple single PC board construction.

K 2510 $99.00



K 2100 $65.00

5W Bench Test Amplifier

(EA April'88)

Test Amplifier For All Occasions

High input impedance. 4 different input sensitivities suits virtually all requirements and delivers 5 watts of power. Complete with own in built speaker.

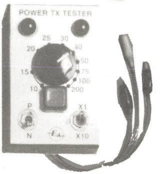
RF Detector Probe

(EA May'88)

Checks R.F. Circuits

Simple effective RF probe traces signals. Ideal companion to the 5W bench test amplifier.

K 2565 $12.00



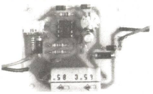
Power Transistor Tester

(EA May'88)

Gain Matched, Power Transistors for Amplifier Output Stages

Super simple circuit, enables evaluation of current gain and Vbe of power transistors & Darlingtons.

K 2532 $24.95



Solar Battery Charger

(ETI Dec'87)

Charge Your Batteries Free From The Sun

Controls the charge of 12V lead acid batteries hooked to a solar cell Ideal for use on boats & caravans.

K 1680 $13.99

Brilliant Performance Stereo Pre Amp

Studio 200 Stereo Control Unit

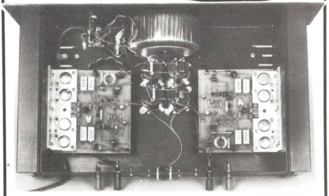
(Silicon Chip June/July'88)

Out-Performs Commercial Units Costing $600 Plus

The Studio 200 Stereo Control Unit is companion to the studio 200 stereo power amplifier (or other power amps). It features slim 1u rackmount profile, treble, bass, balance, input selector, tape monitor switch, stereo/mono switch and volume control. Inputs include phono, tuner, CD, VCR and tape loop.

K 5015 $229

Simple PCB Construction Virtually No Wiring



Calling All Audio Purists

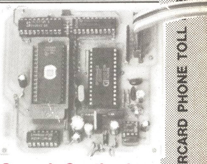
This Great New Amp From Silicon Chip Is For You

Studio 200 Series 100 Watts Per Channel Power Amplifier

K 5010 $399

Features: • In-Built speaker protection • Toroidal Transformer (low hum) • Black Satin Finish • Low leakage power supply capacitors • Housed in Rugged Custom Chassis.

Specifications: • **Output Power** 100W into 8 Ohms **Freq. Res.(at 1W) 20Hz-50KHz** + or - 1db **Input Sensitivity** 870mV **Harmonic Distortion (20Hz-20KHz)** 0.1% **Signal To Noise Ratio** 100db or Better **Protection** 5A fuses plus RDE245A Polyswitch **Damping Factor** (without Polyswitches) 100 (with Polyswitches) 100. **Stability** Unconditional.



Speech Synthesizer

(ETI March'88)

This incredible "Voice" generator will store 127 messages or statements each an amazing 128 bytes long. (A sentence such as "You've left the lights on" uses only 31 bytes)

Simply programmed with an eprom programmer and PC or you can purchase the pre programmed 56 message Eprom Cat.No. K 9502 for just $20.00. Refer to ETI March '88 or request a message listing from us.

On board amplifier easily drives the 3-1/2 inch speaker supplied with the kit.

Fantastic for installing at home, behind your car dash or for interfacing with alarm systems, control systems etc. Requires enternal 12V DC supply. Kit includes 27128 eprom.

K 9500 $85.00

Simply Fantastic!

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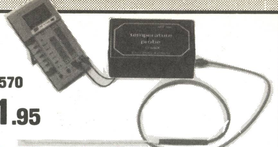
Lab Standard Function Generator Kit. Every Electronics Workshop, Audio Designer, Enthusiast & School can now save a fortune on a commercial unit of comparable performance

K 2540 $155.00

Audio Oscillator and Function Generator

This Ultra low distortion oscillator is comparable with the very best laboratory standard sine wave oscillators. As well as having very low distortion it has excellent envelope stability, square wave output & output metering.

(See EA Dec'86)



K 2570

$21.95

Low Cost Temperature Probe

Here's an easy to build probe design which adapts a multimeter or electronic voltmeter into a general purpose thermometer. It's just the shot for measuring heatsink temperatures, how hot it gets inside your car, or whether little Johnny has a fever!

Measures accurately from -20 deg.C to +120 deg.C.

Congratulations To The Design Team At Sillicon Chip Magazine for this Excellent Design

K 2515 $299.00

1GHz Digital Frequency Meter

(See SC Nov'87 Jan'88)

This superb 1GHz Frequency Meter will out perform many other instruments twice its price.

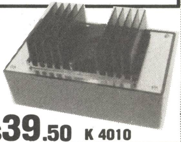
Features: Professional machined and screen printed red perspex front panel • Easy to asemble and construct • No special tools required • Bright Hewlett Packard 8 digit display • Electronic switch latching • High performance IC's • High Quality Components.

Transistor Assisted Ignition With Dwell Extension

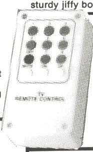
(See EA Feb'83)

Pays For Itself In No Time

Dead easy to build & (even better) there are only 3 electrical connections required to the car wiring system. Now housed in sturdy jiffy box.



$39.50 K 4010



8 Way Remote Control

(See EA June July'86)

Convert your TV, CD, VCR etc to be operated remotely from the comfort of your armchair. Up to eight separate functions can be switched with this infrared remote control.

K 1830 $125.00

Control Your TV Or Stereo From Your Chair

Added Facility

Apart from above - allows for control of On/Off, Mute and volume control.

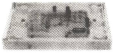
K 1840

$45.00

Touch Lamp Dimmer

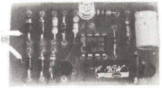
(See EA April'83)

Instantly turn lamps on and off with just a light touch on a wall panel. Alternatively you can dimm or brighten the lamps to any desired level by merely touching the panel for two or three seconds - very classy! The ***Altronics*** kit is complete in every way, including satin touch plates for that prestigeous look. Please nominate plate colour.



Gold	**K 6319**
Silver	**K 6320**

$35.00 ea



K 1400 $9.95

Telephone Off Hook Indication

(See SC Nov'87)

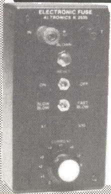
Use where 2 or 3 phones are connected on the one line. If one extension is in use a LED will flash in each of the other extensions. Requires no external supply. Runs off the telephone line. One module required for each phone.

Regenerative Radio

(See EA Jan'88)

Step back in time and build this simple regenerative radio receiver. Using only 3 transistors, its not only fun to build, but uses Varicap tuning.

K 1150 $55.25



This natty service aid allows you to track down short circuits without continually blowing fuses.

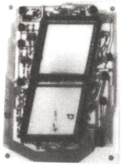
DC Electronic Fuse

(See EA Nov'87)

Replaces Any Size fuse Up To 10A

This unit simply clips across the DC fuse holder. Offers protection adjustable from 0-10A in 2 ranges. In essence its an adjustable DC circuit breaker.

K 2535 $39.50

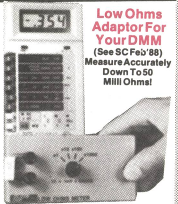


Large 7 Segment Display

This large 153mm high seven segment display can be configured for use as either common anode or common cathode. Multiplexed on DC driver and arranged to have a decimal point on either the left or right handside.

It can be used to interface equipment with existing displays for large elapsed times & digital clocks.

K 1225 $59.95



Low Ohms Adaptor For Your DMM

(See SC Feb'88)

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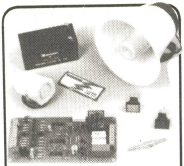

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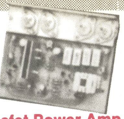

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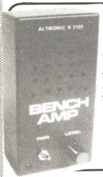

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Etch PC boards faster, with

The Slosher

You've done the resist pattern on your blank PC board, dropped into the etching tank and covered it with ferric chloride. Now you're rocking the tank back and forth to swish the etchant over the copper until the last trace dissolves. Tedious, isn't it? But if you build up this simple project, it'll be a lot easier for your next board...

by FRED HAWKINS

The idea for the slosher came when I was etching a PC board myself, several years ago. Like most people, I was doing what the books say by gently rocking the etching dish, for better aeration and faster action, and to make it easier to see when the last of the unwanted copper disappears. But it sure was tedious.

It came to me that what I needed was a limited travel see-saw, activated by a solenoid and simple timer circuit so that it rocked once every second or so.

I designed and built the prototype slosher several years ago, and have found it to be a useful tool ever since. However there were a few little shortcomings in the original, which prompted me recently to produce an improved "Mark 2" design. Based on the earlier design I'm confident that this new model will serve my needs indefinitely. So if you like to etch your own boards, I can highly recommend it.

In a recent test I prepared a small strip of blank PC board, drew a track down the centre with a "Dalo" pen, and snipped it into three equal samples. The first was left undisturbed in the ferric chloride and took 37 minutes to etch. The second was swished by hand every minute, and took 27 minutes. The third was etched using the slosher, and took 18 minutes. This is quite a worthwhile improvement, I think you'll agree.

The slosher itself doesn't involve many parts, and is easy to build – especially if you don't mind a bit of elementary carpentry. The cost will be minimal, especially if you do as I do and power the slosher from a bench power supply. This saves the cost of a special supply, and is quite logical for something like the slosher which is used only from time to time.

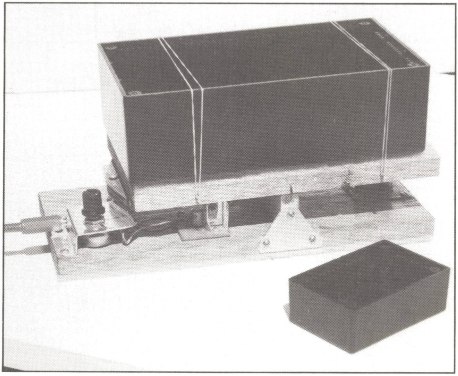
By the way, my favourite etching dish/tank is the nearest size of zippy box that will accommodate the board concerned, although the slosher can also handle microwave dishes if they are mounted "side-saddle". The advantage of using a zippy box is that no one is likely to try cooking a cake or a casserole in a zippy box, even by accident - so any traces of etchant are unlikely to poison the family!

How it works

As you can see the slosher is basically a simple see-saw scheme, activated by a solenoid or electromagnet which is pulsed by a 555 timer chip and BD139 power transistor combination.

When the circuit pulses, the solenoid is energised, pulling the see-saw a couple of millimetres to the level position. This is sufficient to start a small wave from the back of the tank to wash over the board. As the wave reaches the front of the tank, the pulse ends and the rear of the see-saw drops a couple of millimetres until arrested by the adjustable stop, allowing the wave to wash back over the board to the rear of the tank, just in time for the next pulse.

A small zippy box, adequate to handle the board needed for this project itself, works the wave best at about 94



pulses per minute, while the large box works at 36 pulses. These speed variations are controlled by a 20k pot, which gave me a range from 30 to 230 pulses per minute. However, since capacitors can vary quite a bit, a spare pad has been provided on the board to accommodate an additional capacitor in parallel, in the event the low speed is not low enough.

Initially, the circuit originally went into "fibrillation" at about half throttle, hence the small capacitor (C2) mounted on the pot. It was the first one I grabbed out of the parts drawer, although I'm sure a ceramic would work just as well.

Referring to the diagram, at switch-on current flows through R1 to pin 7 of IC1, then via D1 & R2 in parallel to pin 6-2 & C1. This enables pin 3, of IC1, switching on Q1 and energising the solenoid. C1 proceeds to charge up via R1, D1, and RV3, so the voltage at pins 2 and 6 rises.

On reaching 2/3 of the supply voltage, IC1 switches, discharging C1 via R2 and disabling pin 3 – which switches off Q1.

Diode D1 allows a fast charge time, governed by R1 and RV3, and a slow discharge time, governed by R2 and RV3. This sets the solenoid to a duty cycle of around 30%, which is adequate and prevents overheating the solenoid.

Construction

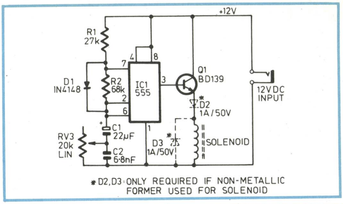
First, the solenoid. Unless someone manufactures a suitable former, the most logical solution would be to have one turned up on a lathe from aluminium, or one of those nice but expensive machinable plastics like "Teflon" or Acetal. The 19mm width between cheeks was chosen to accommodate 18mm wide PVC tape, and 18mm paper masking tape as used by spray painters; both excellent for this purpose. While in the machine shop, you might as well have the 10mm mild steel slug faced nice and flat on both ends, about 5mm longer than the former.

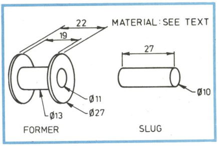
A thought: a 9mm diameter slug would have a cross section area only 81% of a 10mm slug, and that much less magnetic pull.

I actually fabricated the prototype former from copper tube and brass washers, soldered with a mini-Scope; a larger iron would have been preferable. The main thing if you adopt this method of construction is to file the surfaces to be joined clean, tin both parts, then sweat them together.

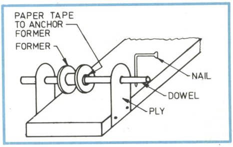
Cover the inner surfaces of the former with masking tape, doing the cheeks

As you can see from this circuit, the electronics side of the Slosher is very simple: just a 555 pulser driving a solenoid via a BD139 power transistor.



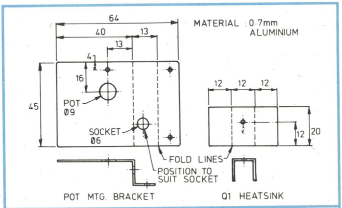


Details of the author's solenoid former and mild steel slug.

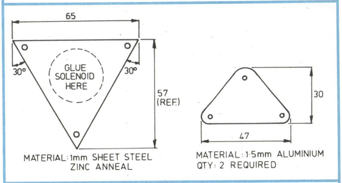


A simple windlass scheme which makes it easier to wind the solenoid.

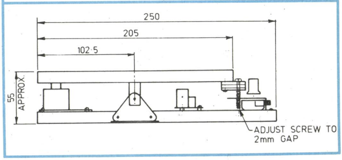
Mechanical details of the pot mounting bracket and power transistor heatsink bracket, both made up from scraps of 0.7mm aluminium sheet.



Details of the solenoid mounting plate, made from 1mm zinc anneal steel sheet, and the see-saw pivot brackets.



Side view of the overall assembly. The electronics PCB fits underneath the see-saw. A screw is used to adjust the maximum see-saw travel to about 2mm.



first followed by a wrap around the tube. This former will accommodate a full 25-gram reel of 0.25mm diameter enamelled copper wire, even when layer wound, i.e., a layer of wire wrapped with a layer of tape, then another layer of wire and so on. This is a tedious way to do the job and probably quite unnecessary, provided you can see the wire well enough to get it on evenly.

I checked the reel before starting to wind; mine had a resistance of 24 ohms and passed 250mA at 6 volts, both before and after winding.

Unless you have a better method the simple windlass illustrated will serve the purpose for winding the solenoid. The former is a firm slide fit on the tape.

Lay one end of the wire across the inside of one cheek and cover with a small piece of tape, leaving about 3cm hanging over the outside. Then wind on all the wire as evenly as possible, and finally down the finish end to the outside with tape while you wrap a couple of turns of tape over the winding. Solder a pair of rainbow leads to the ends and, ensuring adequate separation, bind them under a couple of wraps of PVC.

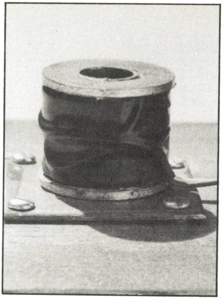
Stand the coil on end on its steel plate, connect power, and lower the slug down the hole. You should be able to lift the assembly by the slug at about 3 volts. By the way, the coil is not worth a cracker without the steel plate.

When satisfied, glue the coil to the plate with super glue, taking care to avoid getting glue in the bottom of the hole.

For the rocking table and base, a flat, straight piece of softwood (maple, oak or similar) 500 × 110mm and 10 or 12mm thick will provide sufficient timber. I used a well seasoned board off a packing case.

Cut off 205mm for the see-saw, 25mm for the fulcrum (taking care not to split it) and 250mm for the base. Glue the fulcrum across the centre of the see-saw with Aquadhere or similar PVC glue. The grain of the timber runs vertically, because you have to drive the pivot screws in, and they won't hold well in end grain. You will also need a scrap of 10mm ply or chipboard about 25 × 50mm, to mount the adjustable stop screw.

Using 4G × 10mm self tappers, mount the solenoid plate to the base. The hole should stand vertically, unless you've fabricated the former, in which case you may need to pack washers under the plate to raise a low side.



A close-up of the author's solenoid, which was wound on a metal former as described in the text.

Now center the slug in the hole, preparatory to gluing to the see-saw by wrapping a few turns of tape around the slug (more than necessary), removing and cutting off excess tape until the slug is an easy push fit in the hole.

Using 4G × 16mm round head brass wood screws, mount the pivot brackets, ensuring the see-saw is level when resting on the slug.

To avoid splitting the timber, counterbore the holes the depth of the screw shank first with a 2.5mm drill, then finish the remaining depth with a 2mm drill. Ease the sides of the fulcrum as necessary (with a file) to ensure free movement of the see-saw.

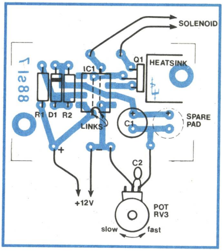
Unless the timber is pre coated, quick drying adhesives can stick to the surface skin only, forming a weak joint. So mark the slug position on the underside of the see-saw, remove the two pivot screws, and with a sharp pointed nail drive a dozen or so holes about 1mm deep in the marked area. Smooth off any splinters and apply a coat of super glue, working it into the holes and finishing by wiping away excess glue. Then remount the see-saw, apply a drop of glue to the top of the slug and bring the parts together, ensuring no glue runs in to the slug hole. Allow several hours for glue to set hard.

After drilling a 2mm hole, drive a sharp pointed metal thread screw (with a screwdriver) more than 30mm long through the 10mm ply, to become the adjustable stop screw. Cut the end off square, such that the length of screw under the head exceeds the gap at the rear of the see-saw by only a millimetre or two. Drill 2 mounting holes through the ply to take 4G × 16mm screws, and set aside.

Now drill the two 4G mounting holes in the PC board, then fit the two wire links which go under the 555 IC (8 amp household fuse wire is ideal) followed by the IC, resistors, diode, and C1.

Bolt the BD 139 transistor Q1 to the outside of the heat sink channel. Then offset the centre pin of Q1 and insert the pins through the board until the heatsink rests on the board, and solder. Also solder rainbow wires to the board as required, and a couple of pins to terminate the solenoid leads.

Mount the pot, C2, and 3.5mm power input socket on the mounting bracket as a sub-assembly. As noted earlier, power projects such as this from the bench supply, using 3.5mm plugs on each end of the wire, although a concentric-type DC power plug and socket would probably fit. Both the mounting bracket and heat sink were cut from a surplus zippy box lid.



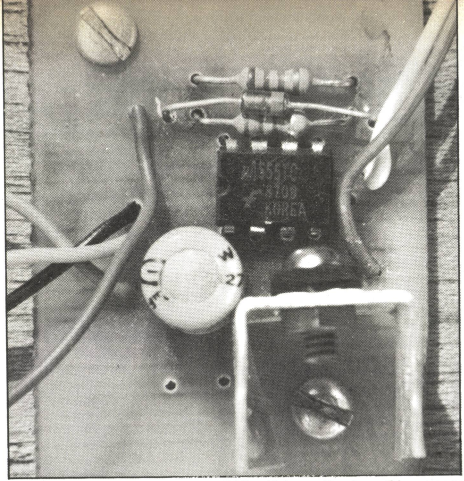
Wiring up the slosher should be easy using this overlay diagram.

Remove the pivot screws, then carefully withdraw the slug from the hole, and unwrap the tape.

To help curb "slithering", I glued 5mm foam rubber on the upper surface of the see-saw and also under the base, using aquadhere. Then I drove a few panel pins along the edge, to anchor tie-down rubber bands.

The 10mm-ply stop block is screwed on with 4G × 16mm roundheads; the pot bracket sub-assembly and circuit board may be positioned (avoid fouling moving parts) and screwed down with 4G × 10mm self tappers, spacing the circuit board off the base with washers.

Connect the wiring and re-fit the see-saw, adjusting the clearance under the



A close-up of the author's prototype PCB, which wasn't quite as tidy as yours will be, because diode D1 was added as an afterthought.

end of the stop screw to 2mm. The rear end must *always* be weighted enough to rest on the stop screw, yet not be beyond the pull of the solenoid, So positioning, especially of larger tanks, can be fairly critical.

Weight the rear end, connect 12 volts, and check the rocking rates against a watch. If unable to get below 32 pulses per minute, fit another capacitor on the spare pad, in parallel with the existing C1.

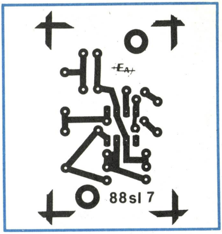
Finally, you may wish to try a couple of different size tanks with water, marking around the speed control with a marker pen at the best speed, as a *guide* for later use. But don't get too carried away with calibrating, as the speed varies with the depth, viscosity, and size of board for a project. EA

A metal solenoid former?

When we first saw Fred Hawkins' design for his Slosher, we were a little unsure about his use and recommendation of a metal former for the solenoid. Not that we're experts in the design of electromagnets – far from it, in fact. It's just that a metal former will tend to constitute a "shorted turn", and in most areas of electronics this is generally undesirable. For example an inadvertent shorted turn will generally ruin the inductance and "Q" of an RF coil or transformer.

But does a metal former/shorted turn cause any problems with a solenoid electromagnet operating on DC? It would appear not. When we checked with Mr Hawkins, it turned out that the same question had occurred to him, and just to make sure he had made up alternative solenoids using both Teflon and metal formers. The results were virtually identical, in terms of magnetic "pull". This suggests that the only practical effect of the metal former may be to dampen the inductive "kick" when the solenoid current is switched on and off. In other words, using a metallic former may actually be an advantage, obviating the need for the usual damping diodes.

But note that if you use a Teflon or other non-metallic former for the Slosher's solenoid, we suggest fitting diodes in series and parallel with the winding, as shown in the circuit schematic.



The PCB pattern for the slosher, reproduced actual size.

PARTS LIST

Electronics

1	555 timer IC
1	BD139 power transistor
1	27k ¼W resistor
1	68k ¼W resistor
1	20k linear rotary pot & small knob
1	IN4148 silicon diode
1	22uf 16VW electro
1	6.8nF metallised polyester
2	Terminal pins, PC board type
1	25-gram reel 0.25 enamelled copper winding wire
1	200mm length rainbow cable
1	3.5mm jack socket
1	PC board, 49 × 31mm
1	Length 8-amp fuse wire (for links)

Mechanics:

500 × 110 × 12mm piece of softwood;
50 × 25mm piece of plywood or chipboard;
65mm triangle of 1mm zinc annealed steel plate;
two 55 × 35mm triangles, 1.5mm aluminium;
aluminium for bracket and heatsink;
aluminium or Teflon former for solenoid;
10mm diameter × 27mm long mild steel slug;
18mm wide PVC tape and 18mm wide paper masking tape;
super glue and Aquadhere PVC glue;
4G × 10mm binding head self tappers (7);
4G × 16mm round head brass woodscrews (8);
35mm binding head metal thread or self tapper screw;
25mm panel pins (6).

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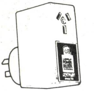

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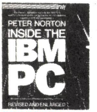

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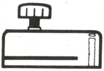

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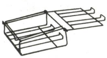

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- Conveniently stacks paper printout in document tray automatically
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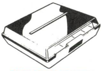

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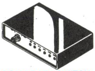

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Seagate drive. IBM* compatible. 12 month warranty
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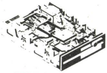

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- 1 M Byte unformatted. (640K formatted).
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- Switchable 1 6 M Byte to 1 M Byte unformatted
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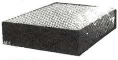

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Compatible with Apple 2 ·
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- 720K formatted capacity
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- Size 266(D) x 104(W) x 75(H)mm

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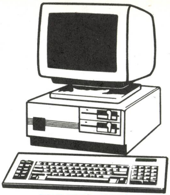
- Copy area 9¹ 2" x 11
- Sliding line guide
- Flat metal base

C21060 .... **$39.95**



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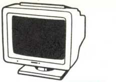

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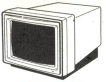
SPECIFICATIONS:
CRT: 14 inch (360mm) diagonal, 90 degree deflection.
Display Size: 245(H) x 180(V)mm
Phosphor: P22, non glare, tinted screen.
Dot Pitch: 0.31mm
Video Bandwidth: 18 MHz
Resolution: 15·75KHz - 640 x 200
21·85KHz 640 x 350
Input Signals:
1. RGBI - positive, H(+), V(+)
2. RrGgBbI - positive, H(+), V(−)
Input Impedance: TTL Level (330 ohms)
Dual Scanning Frequency:
Horizontal: 15·75 KHz or 21·85 KHz + −10Hz
Vertical: 50 - 60 Hz
Connector: 9 pin, D-type
Size: 312(H) x 363(L) x 380(W)mm
Weight: 10·8 Kg (Net)
X14525 .... **$895**

SAKATA 13" RGB COLOUR MONITOR

High quality IBM* compatible monitors, great with VCR's too!

SPECIFICATIONS:
CRT: 13". 90° deflection colour
Input Signal:
Video Signal: Separate video signal
Video: Positive
Sync.: Positive
Input Level: TTL Level
Scanning Frequency:
Horizontal: 15.7KHz
Vertical: 60Hz
Display Size: 245(H) x 182(V)mm
Resolution:
Horizontal: 640 dots
Vertical: 200 lines
Size: 343(H) x 362(W) x 421(D)mm
Weight: 11.6kg
Cat X14530 .... **$695**



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X14514 (GREEN) **$129**
X14516 (AMBER) **$129**
(10 OR MORE $119 EACH!)

RITRON 2 MONITORS

Stylish monitors available in green or amber displays and featuring swivel base that tilts forward and back 30 degrees and swivels right to left 60 degrees!

SPECIFICATIONS:
CRT DISPLAY SIZE: 12 inches non-glare 90 degree deflection.
INPUT SIGNAL: 1.0 - 2.5V p-p composite video signal.
INPUT INPEDANCE: Normal 75 ohm, high approx. 50K ohm.
INPUT TERMINALS: RCA phone jack.
RISE AND FALL TIME: Less than 25 us
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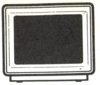
Corner; 800 lines
Geometric distortion; 2% or less
Linearity; less than 2%
CONTROLS: Front; Power On/Off, brightness, contrast
Rear; Vertical hold, Horizontal hold, Vertical line, Vertical size.
Green Cat. X14506..**Normally $179**
Amber Cat. X14508..**Normally $179**
NOW ONLY $139



ZDIN TTL 12" MONITOR

SPECIFICATIONS:
TUBE: 12". 90°. non glare. dark screen.
SIGNAL CONNECTOR: 9 pin "D" connector
INPUT:
Input signal: Separate signal with intensity
Video Input: 4·0V p-p · 1·5V. positive going
Horizontal Frequency: 18·44 KHz
EXTERNAL CONTROLS: On Off. Brightness. Contrast. V-Size. V-Hold. V-Line
VIDEO
Display Area: 210 x 150mm
Display Format: 25 lines. 80 characters per line. 9 x 4 dots per character block.
Frequency Bandwidth: 22MHz
Resolution: 900 lines at centre 80 characters x 25 lines
POWER
Consumption: 35W
120V AC, 50Hz, 0·15A
DIMENSIONS:
327(W) x 310(D) x 286(H)mm

Cat.No	Description	Price
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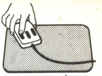

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WITTY MOUSE

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- A specially silicone coated steel ball transfers mouse movement to internal motion encoders without the need of a special surface. Smooth gliding over any hard, even surface.
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- Optical rotary encoder
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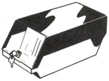
- Mouse resident firmware
- Auto repeat key
- 1·5 metre lead
- DB25 socket connector
- Weight: 212 grams
- Size: 116 x 66 x 34mm

Cat.X19950 .... **$79.00**

NOTE: HARDWARE ONLY. SOFTWARE NOT INCLUDED



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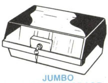
Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 100 x 5¼" disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact ABS plastic base
- Contemporary design

C16020 **only $17.95**



JUMBO 5¼" DISK STORAGE (DD120-L)

If you have lots of disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating a particular disk.

Features...
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- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact plastic base

C16028 .... **only $22.95**

3½" DISK STORAGE (DD80-L)

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- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact plastic base
- Contemporary design

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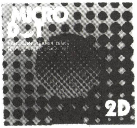

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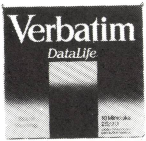

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(ALL PRICES PER 10 DISKS)

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5¼" 1S/2D	$22.00	$21.00
5¼" 2S/2D	$26.00	$24.00
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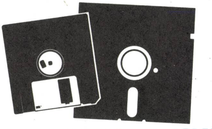

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3½" 2S/2D "NO BRAND" DISKS

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Basic Principles of VCRs - Part 2

Video recording systems

In this second article in our series discussing the operation of video cassette recording, the author describes the way video signals are recorded using the VHS, Betamax and Video 8 systems.

by DAVID BOTTO

One of the problems encountered in recording video signals is that the bandwidth of a modern 625-line TV receiver is several megahertz. Fig.1 shows the TV station bandwidth for Australia.

In part one of this series we discussed the use of helical recording. In this system you will remember two video heads with very small gaps are set into a rotating drum at an angle to the moving magnetic tape. TV picture information recorded in this way first passes through a special filter circuit. This reduces the bandwidth to about 3MHz (a wider bandwidth is possible with the newer VCR's). The luminance or detail of the picture is then recorded as a frequency modulated signal, and the chroma information as a 627kHz "rotational" signal using the luminance.

In early domestic video recorder systems, interference was experienced between the video "tracks" because as the two video heads scanned the tracks each tended to pick up some picture information from the two adjacent tracks. To prevent this occurring, *guard bands* were used (Fig.2). The space between the tracks became a wasted area and considerably decreased the total recording time on the tape.

The VHS Format

The need for guard bands was overcome by the use of *azimuth recording*, where the gaps of the two video heads are not at 90° to the direction of writing along the track, but offset at complementary angles to each other – one at minus six degrees and the other at plus six degrees (VHS system).

Fig.3 is a sketch showing the basic construction of a typical VHS drum assembly. The magnetic tracks are then laid down as in Fig.4. The azimuth angle prevents the video head scanning say track "X" from picking up any sig-

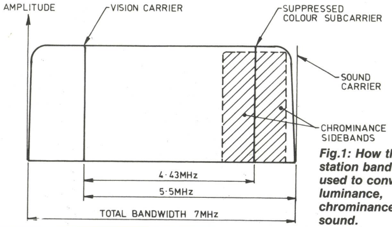


Fig.1: How the TV station bandwidth is used to convey luminance, chrominance and sound.

Fig.2: A helical-scan video recording consists of oblique tracks, separated by blank strips known as 'guard bands'.

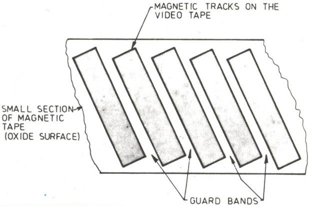
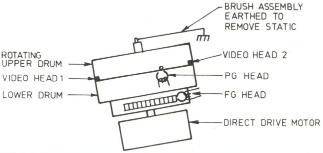

MAGNETIC TRACKS ON THE VIDEO TAPE
SMALL SECTION OF MAGNETIC TAPE (OXIDE SURFACE)
GUARD BANDS

Fig.3: The basic structure of a typical helical scanning drum as used in the VHS system.



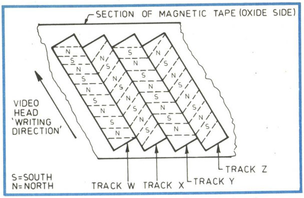

SECTION OF MAGNETIC TAPE (OXIDE SIDE)
VIDEO HEAD 'WRITING DIRECTION'
S=SOUTH
N=NORTH
TRACK W
TRACK X
TRACK Y
TRACK Z

Fig.4: In 'azimuth' recording, alternate tracks are written with lagging and leading head gap azimuth.

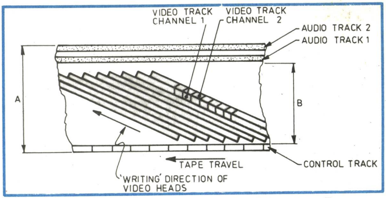


Fig.5: The basic track format used for the VHS system. Tape width A is 12.5mm, while video track width B is 10.6mm.

nificant signal information from tracks "W" or "Y". Similarly when track "Y" is scanned information on tracks "X" and "Z" is not picked up. This results in a greater density of recorded material and a longer tape playing time.

As an example, in a standard two head VHS recorder an E-30 tape cassette contains approximately 45 metres of magnetic tape and plays for thirty minutes. An E-180 cassette contains approximately 258 metres of tape and runs for 3 hours. The tape holding the magnetic material is typically composed of high quality polyester film.

How the magnetic tape information is arranged on a VHS tape is shown in Fig.5. The letter 'A' on the sketch indicates the total tape width of 12.65 millimetres. The letter 'B' indicates the video track width (10.60mm).

Each video track has a width of .049mm. At the top of the tape the audio track is shown. Where a single audio track is used it is 1mm wide. If two separate audio tracks are required for stereo reproduction they are each 0.35mm in width. Alternatively each track may hold a different spoken language, in which case the desired language can be electronically selected by the VCR circuitry.

At the lower edge of the tape is a 0.75mm wide *control*, or synchronization track. We will discuss this track in more detail in the next article.

The VHS cassette and deck threading format is shown in Fig.6. The tape speed is 23.39mm per second, ±0.5%. A loop of magnetic tape is pulled out from the cassette by the VCR mechanism and arranged as shown. The tape feeds from the supply spool past the supply guide pin "A", the tension pin "B" and guide post "C". It then passes over the surface of the full erase head "D". When the VCR is in the RECORD mode this head is supplied with an AC sinewave bias signal of which has a typical voltage of about 115V peak to peak. This signal removes any previous recording(s) that may be on the tape.

The tape next passes inertia roller "E", over supply guide roller "F" and supply slant pin "G". It now travels round the video head drum, contacting just slightly more than half of the drum at any given moment. The direction of the drum's rotation is shown by the arrows.

The tape now continues its journey and moves around the take-up slant pin "H", around the take-up guide roller "I" and across the heads of the audio erase/audio record/playback head "J" and control head "K". The tape next continues past the take-up guide pin "N", through the capstan "L" and pinch roller "M" and back into the cassette onto the take-up reel. Notice that both video drum and tape travel in the same direction. The tape-to-head or head *writing* speed is 4.85 metres per second.

The VHS format is sometimes referred to as an "M" format, because as you can see from Fig.6 the tape path resembles an "M".

"Pause" or Still mode

As *Electronics Australia* readers will know, most modern VCRs are fitted with a "pause" or still capability. When this mode is selected the tape movement stops, but the head drum continues to rotate and the two video heads continue to scan the video tracks.

When the stationary tape is scanned by the heads the writing path of the two video heads inevitably changes in relation to the magnetic video tracks. The dotted lines in Fig.7 show the stationary scanning path of the heads. This means that in the "still picture" mode, some picture information is lost. Remember an azimuth mounted head can only pick up signals from video tracks recorded at its own azimuth angle.

With a two head recorder this prob-

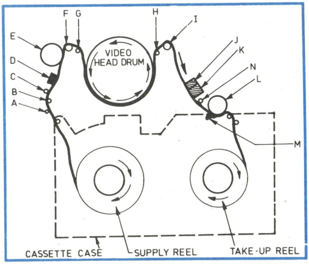


Fig.6: The tape threading format used for VHS recorders, often described as the 'M' format. Head drum wrap is slightly more that 180 degrees.

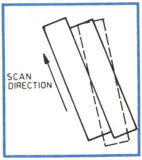


Fig.7: In 'pause' mode, the head scanning path overlaps adjacent tracks because the tape is no longer moving. Due to the azimuth recording, some information is lost.

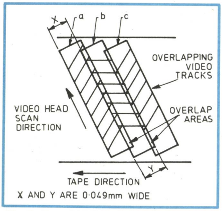


Fig.8: By widening the video tracks so they overlap, picture quality in pause mode is improved.

lem can be partly overcome by making the video heads slightly larger than the tracks to be laid down on the tape in the record mode. Each video head then records a pattern that slightly overlaps the previous video track, as shown in Fig.8. With a recording made on track "a", when a recording is next made on track "b" a strip along the edge of track "a" is erased and re-recorded. Then when a recording is made on track "c" the overlap strip of track "b" is erased. In this way a pattern of video tracks exactly 0.49mm wide is laid down, as shown in Figs.4 and 5.

Because of the slightly larger size of the video heads, as each track is scanned on normal playback it passes over a portion of the two adjacent tracks. However because these tracks have been recorded with an azimuth difference of 12 degrees away from the correct track (due to the +6/−6° azimuth alternation), each head picks up signals only from its own track. Notice that although the wider heads overlap, the track widths at 'X' and 'Y' are still 0.49mm.

When the "still" picture mode is required, because the video heads are now wider than the video tracks overlapping them, the video heads are able to pick up more of the picture information and a better still picture is obtained. But the still picture may suffer from jitter and loss of definition.

However many VCRs have extra video heads, and use other advanced techniques to produce excellent still pictures. For example the latest National VHS machines use a very advanced four video head system that produces still and slow motion pictures of superb quality. How this is accomplished we'll discuss in later parts of this series.

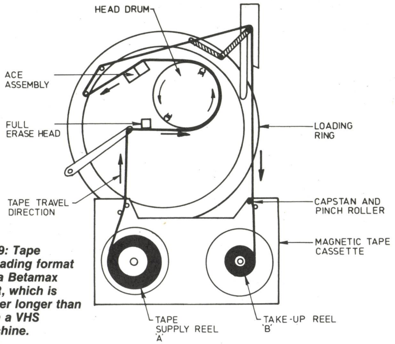


Fig.9: Tape threading format for a Betamax VCR, which is rather longer than with a VHS machine.

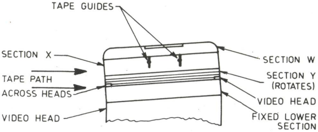


Fig.10: The basic arrangement used for a Betamax head drum assembly.

Sony's Betamax system

Fig.9 is a sketch of the basic Betamax tape deck, showing the magnetic tape "threaded" and ready for use. Reel "A" is the supply reel and the magnetic tape passes via the guide and tension arms over the full erase head. In the record mode this head is fed with a supersonic AC bias signal to remove previous recordings. (For example 65kHz in the Sony model SL-C6UB VCR).

The tape now travels around the head drum and over the audio/control head unit (ACE assembly) and continues via the capstan and pinch roller back to the cassette's take-up reel.

The design of the Betamax video head drum assembly is quite different from a VHS unit (see Fig.10). Section "W" is the fan, section "X" the upper drum assembly. Section "Y" contains the two rotating video heads. Sections "W" and "Y" rotate in the same direction as the tape movement. A rough comparison is to a slightly lop-sided stationary cream cake, with the cream layer and icing top rotating!

The azimuth angles of the video heads in the Betamax system are +7 and -7 degrees. For play and record modes the magnetic tape speed is 18.7mm per second, slower than the 23.39mm per second of the VHS system. However the writing speed is 5.83 metres per second, which is faster than the head to tape speed of the VHS format.

Fig.11 shows the arrangement of the magnetic information on a Sony Betamax tape. The total tape width "A" is 12.7mm. Each video track has a width of .0328mm. The audio track "C" at the top of the tape has a width of 1.05mm for mono sound. If stereo or alternative language tracks are used ("D" and "E"), each is 0.5mm wide. The control track width "F" is 0.6mm.

Incidentally, regular cleaning of the video heads is necessary with all VCR systems. This should be done ONLY with a proper video head cleaning kit and strictly according to the manufacturers instructions. Video heads are easily damaged if mistreated and expensive to replace.

Betamax recording

The bandwidth of the recorded luminance signal with Betamax is about 3MHz. As in the VHS system the luminance or detail information of the picture is converted and recorded as a frequency modulated signal. However the circuit arrangements are quite different.

The amplitude modulated PAL colour signal is down converted to a 687.5kHz rotational signal. Circuitry in the Betamax machine offsets this frequency to feed a 685.546kHz signal to one video head, and a 689.453kHz signal to the other.

There has been much discussion regarding the relative merits of the VHS and the Betamax systems. However both systems are the result of brilliant research and engineering.

Philips' V2000 system

This system, developed by Philips and Grundig, used two sets of video tracks. At the end of the tape play or recording process the cassette was withdrawn from the machine and turned over in a similar way to a compact audio cassette. It was then re-inserted so that the other set of video tracks could be used.

The video track width was only .0226mm. The system also used a special technique, known as *dynamic track following*. The head writing speed was 18.73 metres per second. Both moving and still pictures were of excellent quality. However Philips have now replaced the Video 2000 system with their own VHS system.

Sony's Video 8 format

This system, first seen in Britain and Australia in 1985 has proved extremely popular and looks certain to be one of the main systems in the years ahead. It uses helical scanning like the VHS and Betamax systems, but on tape only 8mm wide.

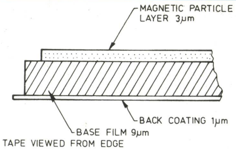


Fig.12(a): The structure used for a 'Metal Power' video tape.

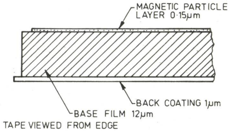


Fig.12(b): Metal evaporated (ME) tapes use this slightly different arrangement.

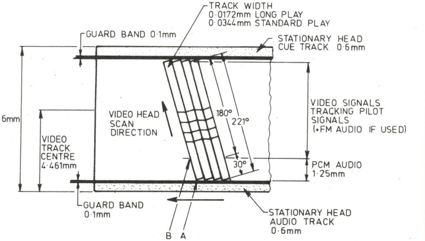

TRACK WIDTH
0·0172mm LONG PLAY
0·0344mm STANDARD PLAY
GUARD BAND 0·1mm
STATIONARY HEAD CUE TRACK 0·6mm
6mm
VIDEO HEAD SCAN DIRECTION
180°
221°
VIDEO SIGNALS TRACKING PILOT SIGNALS (+FM AUDIO IF USED)
VIDEO TRACK CENTRE 4·461mm
30°
PCM AUDIO 1·25mm
GUARD BAND 0·1mm
STATIONARY HEAD AUDIO TRACK 0·6mm
B
A

Fig.13: The various tracks on Video 8 recording tape. Note that the lower longitudinal audio track is not in current use.

The cassette used in the Video 8 system measures only 95 X 62.5 x 15mm. This is much smaller than a VHS cassette (188×104×25mm), or a Betamax cassette (156×96×25mm). The cassette may contain either of two kinds of high quality magnetic video tape.

Fig.12(a) shows the composition of the MP (metal powder) type. The magnetic track consists of powder of alloy of iron mixed with nickel and cobalt. This type of tape has high durability and runs very smoothly through the tape transport mechanism. Fig.12(b) shows the metal evaporated (ME) type tape. ME tape is particularly suitable for high density recording.

The tape speed for Video 8 (PAL colour system) in the standard play mode is 20.051mm per second. In the long play mode it is 10.058mm per second.

The magnetic "tracks" on the Video 8 tape are arranged as in Fig.13. Notice that a section of each helical track is used for the pulse code modulation

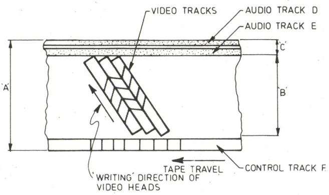


Fig.11: The track format used on standard Betamax video tape.

(PCM) audio. PCM is an extremely sophisticated analog-to-digital recording process using compression/expansion.

Three methods are available for the recording and playback of audio signals in the Video 8 format:

1. Frequency modulated (FM) mono recording with compression/expansion (companding) via the video heads, on the section of the tracks between "B" and "C";
2. PCM stereo audio, again via the video heads, on the section of the tracks between "A" and "B"; and
3. An auxiliary mono audio track via a fixed head, using the longitudinal track along the bottom of the tape.

All current Video 8 camcorders and VCRs are equipped with the FM audio systems. A few machines, such as the Sony EVS-700, also provide the PCM system.

When the record mode is selected and the video heads start to scan a track (see point "A"), the PCM sound signals are first recorded. Then when the heads reach point "B" the video signals are recorded. In the playback mode the sound section of each track is again scanned first and then the video section.

The head writing speed is 3.12 metres per second in the standard play mode, and in the long play mode 3.13 metres per second. This slower writing speed is made possible because of the use of very high quality magnetic tape cassettes, and video heads of advanced design with extremely small head gaps. The azimuth angle of the heads is +10 and -10 degrees. In the standard play mode the video tracks are .0344mm (34.4 microns) wide, and in long play mode they have a width of .0172mm (17.2 microns).

As in the standard video formats only half the head drum (180 degrees) contacts the magnetic tape at any time in order to handle the video signals (Fig.14). However you may have noticed that in machines using PCM, an additional 30 degrees is used in order to scan the PCM audio section.

The drum diameter is 40mm. This reduced drum size, together with the smaller tape width and tape cassette make the whole Video 8 system very compact.

Fig.15 shows the tape path in a Video 8 machine when loading of the cassette is completed. As you can see, it is broadly similar to that used in Betamax machines.

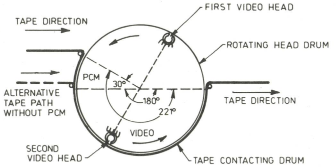


Fig.14: With Video 8, the tape wraps around the head drum by either 180 or 221 degrees, depending on whether PCM is used to record the sound.

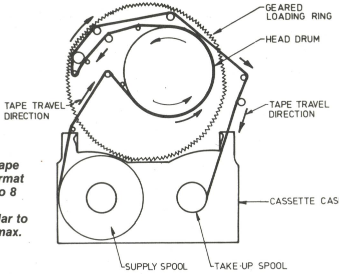


Fig.15: The tape threading format used in Video 8 machines, broadly similar to that of Betamax.

As in other systems the luminance signal is converted in Video 8 recorders to a frequency modulated signal before being supplied to the recording heads. The chroma signals are down converted to 732.422kHz.

Automatic track following

In both the VHS and Betamax formats, signals are recorded on the control tracks in order that circuitry in the playback VCR can synchronise the head position with the video tracks at the correct speed.

The Video 8 format uses *automatic track following* (ATF) to accomplish this. With each field of the picture one of four pilot tones is recorded along with the luminance signal on one video track. There are four of these pilot frequencies: 101.024kHz, 117.188kHz, 162.760kHz and 146.484kHz. These pilot tones are used by circuitry in the 8mm VCR to assure proper tracking, by controlling the phase of the capstan motor. This system was originally proposed by Philips, for the V2000 system.

Flying erase head

Mounted on the Video 8 head drum at 90 degrees from the main video heads is an additional head, known as the *flying erase head*. Using this head very precise erasing of only the desired video tracks is possible.

Bandwidths

Both the Video 8 format and the new super-VHS system (S-VHS) record and play back signals of improved bandwidth, giving superior pictures and colour.

Next month in part three we'll examine VCR control systems, including microprocessors. We will also consider tape control tracks and how they operate, including the pilot tone system of the Video 8 format. In part four we will look further into the recording systems used in the VHS, Betamax and Video formats.

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How good are YOU at designing a really novel and exciting hobby electronics project? Now's your chance to prove what you can do –

The Grand Aussie Hobby Electronics Contest is sponsored by *Electronics Australia*, the country's leading electronics magazine, and leading electronics retailer Dick Smith Electronics. The contest is open to all Australian electronics hobbyists, although entries must be accompanied by the entry form below (or a photocopy if you don't want to cut the magazine).

The idea of the contest is to encourage more Australians to take up electronics as an exciting and rewarding hobby. We're doing this by asking you to design the most novel, exciting, useful and easy to build project you can dream up – provided that the total current retail cost of the parts required to build it is less than $100.

It can be an electronic game, a test instrument, a radio set, a piece of amateur radio gear, an amplifier, an audio accessory, a useful gadget for use around the home or office or whatever, as long as it meets the above requirements. Now that shouldn't be too hard, should it?

Needless to say, you'll be expected to build up a neat prototype of the project, to make sure that it works properly. And to produce the usual things needed in a good project design to make sure that others can build it up easily: things like a printed circuit board pattern, and so on.

Each project entered in the competition should also be accompanied by a description of what it is, how it works and how to build it and get it going. In short, the manuscript of an article which could be used to describe it in *Electronics Australia* – complete with neatly drawn circuit and any other diagrams as necessary.

Not surprisingly we'll be awarding points not just for your project design itself, but for the way you've built up the prototype and your description of it as well. In short, for your overall presentation.

Along with the main prizes, there are two runner-up prizes in each category as well. In each case these are Open Vouchers, to purchase components or other products of your choice to the value of $100, at Dick Smith Electronics.

Rome wasn't designed and built in a day, and neither are good electronics projects. That's why we're giving you three months to prepare your entry. The closing date is September 30, so entries sent to us but postmarked after that date won't be eligible for the competition. The winners will be advised by mail before the end of October, and will be announced in the December issue. If possible we'll also be presenting the winning projects in that issue, as well.

What encouragement is there for you to enter this exciting new competition? Well, for a start there are some great prizes. All up, the total value of prizes being offered is over $3500!

To be fair to both newcomers and more experienced hobbyists, we've decided to award not one but TWO main prizes – one for people in each category. The two prizes are of roughly equal value (both more than $1500), but structured to suit people at different stages of hobby involvement. In each case they provide a mouth-watering collection of the things you've probably always wanted, but couldn't really afford. At the same time they'll provide a tremendous boost to your home workshop, and help you move on to even bigger and better things – what could be more appropriate for a contest designed to encourage hobbyists!

Along with the main prizes, there are two runner-up prizes in each category as well. In each case these are Open Vouchers, to purchase components or other products of your choice to the value of $100, at Dick Smith Electronics.

In addition to these prizes from Dick Smith Electronics, the winning and runner-up project entries are likely to be published in *Electronics Australia* – the largest selling and most respected electronics magazine in Australasia. How's that for being seen by the largest number of your fellow hobbyists – and having them build YOUR design! When your design is published, you will of course receive the usual contribution

OFFICIAL ENTRY FORM:

Here's my entry to the contest. I affirm that this is an original design by me, and that I have built and tested a prototype unit to make sure that it works as claimed. The accompanying description is also all my own work. If my entry is judged one of the winners, I am happy to supply the prototype unit to EA and DSE for testing, photography and preparation of a kit.

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Needless to say Dick Smith Electronics is also going to be interested in producing kits for the winning projects, to make it easy for other readers to build them up. So you'll receive not only fortune but fame as well – what more could you possibly want?

So don't delay – start working on your entry today. Whether you're a keen beginner or an experienced old-timer, you have an equal chance. Put on your thinking cap, and see if you can come up with a winning design!

A final point. To make it even easier for you to work on your entry, Dick Smith Electronics has decided to offer a special 10% discount on the components you may need to build up your prototype. So if you cut out the voucher on the bottom of this page and take it to your nearest DSE store, it will get you that very handy discount. How's that for being helpful!

Please note, however, that you must use the original voucher from the magazine – photocopies can't be used. The voucher can also be used only to purchase electronic components and associated hardware such as a case, knobs, connectors and PCB materials – not for other products. So write out a list of all the bits you'll need for your project entry, and make sure you get them all at once to take advantage of the 10% discount.

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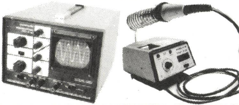

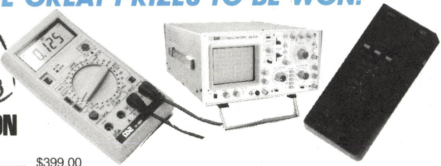

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(All prizes listed above are being donated by Dick Smith Electronics, and further details of each product can be found in the company's latest catalog.)

Prize winning entries and other selected entries may also be published in Electronics Australia, and all entries so published will of course earn an appropriate publication fee, in addition to any prizes awarded.

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To make it especially easy for you to enter the Grand Aussie Hobby Electronics Contest, Dick Smith Electronics is offering this special discount voucher. By presenting the voucher at any Dick Smith Electronics store when you're buying the parts to build your project entry, you'll get a very welcome 10% discount!

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Surface mount update:

Smaller-scale production gear surges ahead

At first the main impact of surface mount technology was at the "top end", with large and expensive machinery for high volume production. But this seems to have slowed, particularly in Australia – where there has been a surge in installations of smaller and more reasonably priced SMT production gear.

by JIM ROWE

It's not all that surprising that installations of high-end SMT production equipment in Australia have slowed, because we really don't have that many electronics manufacturers large enough and involved in enough high-volume production to justify this level of investment.

On the other hand we do have a much larger number of small and medium-sized companies who are involved in lower volume production. And with the emphasis nowadays on high technology products and manufacturing that is truly competitive on an international basis, these are the very companies who both can and do need to take advantage of efficiency-boosting techniques like surface mounting.

In some ways it was therefore unfortunate that the first wave of SMT production equipment produced was designed specifically for larger scale manufacturing. But this is understandable, as it was undoubtedly intended for the much larger potential markets existing in the USA, Japan and Europe.

A year or so ago, the first of a second wave of smaller and more economical automatic SMT production equipment started to appear, mainly from Japanese manufacturers. One of these was the camera maker Mamiya Denshi; another was the diversified Yamaha Motor company. These have both produced compact and lower cost SMT pick-and-place machines which are much more suited to the requirements of most of Australia's electronics manufacturers.

Not surprisingly, local manufacturers have been fairly quick to take advantage of this development. It wasn't lack of awareness about the advantages of SMT that was holding them back, just an inability to justify the large outlay required for top-end machinery. So as soon as the more appropriately scaled equipment became available, the barrier was removed.

The Australian representative for both Mamiya and Yamaha is Hawker Richardson, which demonstrated the first of Yamaha's new compact modular YM series pick-and-place machines at last year's IREE Convention in Sydney. It also demonstrated the smaller Mamiya "Superhand" ECM-8300 machine at the same time, and both created considerable interest.

Since then the company has been quietly selling and installing these lower-level SMT production systems into a variety of local electronics factories, much to the reported chagrin of firms marketing the high-end gear.

According to Alan Springett, Hawker Richardson's NSW representative, in the last 6 months the company would have sold more SMT production equipment than any other competitor, and would now have installed almost as many systems as all other competitors combined.

Alan is in no doubt that this is because machines like the Yamaha YM-4600 and Mamiya ECM-8300 are lower in cost than the larger machinery, and are therefore more within the reach of our generally smaller manufacturers. Instead of requiring an investment in the range of $500,000 to $2 million, they offer a way to get into automated SMT for as little as $50,000 – much less daunting.

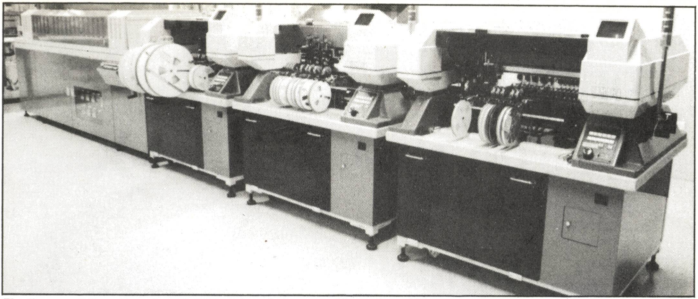
Not only that, but as Alan points out the smaller machines are generally more *flexible* than their larger brothers, and better suited to the needs of smaller companies. For example the smaller machines are generally easier to change over from assembling one product to another and back again. The lower unit cost also makes it easier for a small company to expand its SMT production facilities in affordable stages, as business grows.

Even for larger companies with a larger budget it can still be preferable to invest in a number of smaller machines rather than one larger unit. As well as giving greater flexibility this can also provide significantly greater *reliability*: when one machine is down, the other(s) can carry the load to maintain production.

To illustrate the actual capabilities of these lower-level SMT systems, Hawker Richardson can supply a Mamiya ECM 8300 pick and place machine for around $42,000 plus parts feeder options. This machine can place between 1400 and 1800 parts per hour, and can be fitted with as many as 48 parts feeders. It has two heads (dispenser + placer) and will accept boards up to 420 x 240mm.

When teamed with a suitable solder paste printing machine and IR reflow soldering machine, the overall annual cost would be about $20,000 (before tax write-offs), based on 5 year usage. This is obviously well within the reach of smaller manufacturers, and represents a tangible asset that can be utilised for 24 hours a day and if necessary 7 days a week.

The larger and faster Yamaha YM4600S machine costs around $68-70,000 plus parts feeder options. It can accept up to 48 parts feeders, and can have 3 heads mounted – one of which can be an epoxy adhesive dispenser. It can place over 4000 parts per hour, on boards up to 330 x 250mm.



The line-up of three Yamaha YM-4600 pick and place machines plus a YM 3000S infra-red reflow soldering machine, at General Power Controls, located at Penrith in western Sydney.

Larger again is the YM6000S, which offers the same speed as the 4600 but can accept up to 60 parts feeders and boards up to 457 x 407mm. It costs around $90,000 plus parts feeders.

Both Yamaha models have an in-line board feeding system so that multiple machines can be connected in series, for boards requiring either placement of a larger number of different parts, or higher board throughput. Two YM4600S machines can place between 6000 and 8000 parts per hour, for example, and achieve considerably greater reliability than a single larger machine.

The multiple machine approach offers a lot of appeal for Australian manufacturers, and Alan Springett notes that it has already been adopted by such firms as telephone maker Tytel and diversified equipment maker General Power Controls. Both companies have multiple Yamaha 4600 pick and place machines, and are apparently quite impressed with the performance.

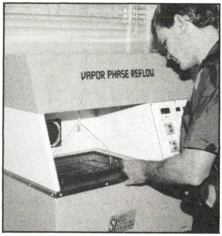
Alan Hicks, manufacturing manager at Tytel, says that his company is very happy with its 4600S and 6000S placers, which are augmented with a YM1000D adhesive dispensing machine and matching loader and unloader. However he noted that making the transition to SMT from conventional leaded technology wasn't entirely easy:

"There's quite a lot of re-learning to do," he said, "which tended to give us a few hassles. Some of these were with our wave soldering system, and I'm still not convinced that wave soldering is the right choice for SMT. We're now trialling a Manix IR-150 long-wave infrared reflow system, and this looks much more promising."

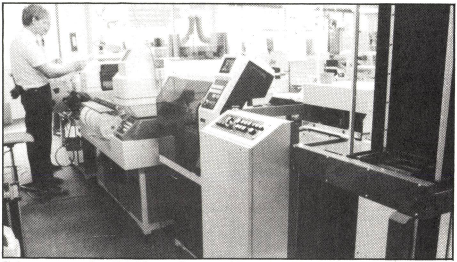
On the other hand a rather happier report came from Fred Morris, GM of General Power Controls. Mr Morris says his company has made the transition to SMT much more easily than expected, and is delighted with the results so far.

"So far we've moved two of our products over to surface mount very smoothly, and we're in the process of moving three more," he said. "I'd say we launched into SMT with remarkable ease, considering the horror stories we've all read about."

"But then, I must admit that we have been heavily involved in automated assembly with conventional leaded parts for about 5 years now, so the transition to SMT wasn't such a big one. We do

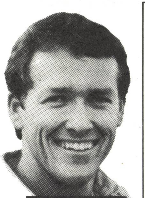


A Surf Systems VP-300 vapour phase reflow station in use at Cochlear Pty Ltd, maker of bionic ear implants.



Telecomms maker Tytel has a line-up of Yamaha YM 4600S and 6000S pick and placers, YM 1000D dispenser, YM 1400L/UL loader and unloader, plus a Manix IR150 IR reflow station.

This man isn't a computer expert, yet he chose a UNI-X CompuPak kit – and assembled it in one night!



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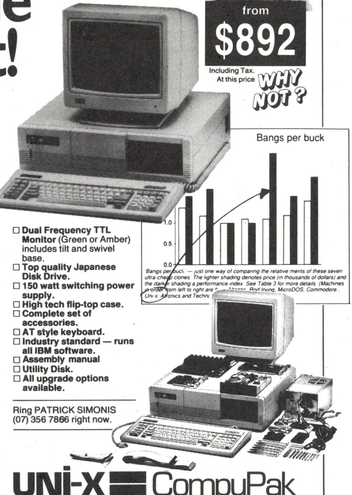

'Bangs per buck' — just one way of comparing the relative merits of these seven ultra-cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines in order from left to right are: ... Atlantis, Rod Irving, MicroDOS, Commodore, Uni-x, Atronics and Techn

No, he's not a genius, but he's brilliant at spotting great value. Like many of us, he's realized that a personal computer is invaluable, yet the price tag for a professional unit has always been a little beyond his reach. Until now.

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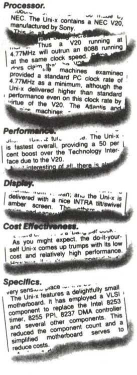

Processor.

NEC. The Uni-x contains a NEC V20, manufactured by Sony.

This is all

Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed.

machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and machines

Performance.

The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

interesting of all, there is al

Display.

and the Uni-x is delivered with a nice INTRA tilt/swivel amber screen.

Cost Effectiveness.

a bang per buck.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance.

Specifics.

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The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

. . . see for yourself in the full Report in the October '87 issue, or ring us for a copy.

Surface mounting explained

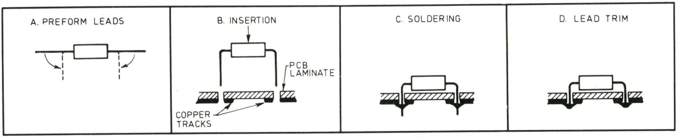


Fig.1: The basic steps involved in PCB assembly using conventional leaded parts.

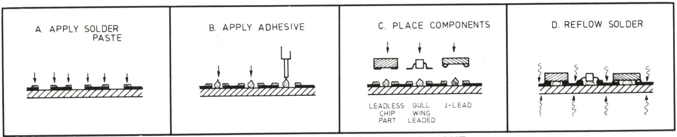


Fig.2: For comparison, the basic steps involved in assembly of a PCB using SMT.

Surface mount technology or SMT isn't hard to understand. It's essentially just a more efficient way to mount electronic components on printed circuit boards (PCBs), compared with the techniques previously used.

Conventional components with "pigtail" leads must often have these leads formed into shape before they can be passed through holes in the board, soldered and then trimmed (Fig.1). These procedures are fairly messy, and are not well suited for automatic production.

In contrast, SMT uses either "chip" components which have no leads at all, or components with modified "gull-wing" or "J" shaped leads, which are mounted directly onto the copper side of the PCB (Fig.2). Generally these components can be made somewhat smaller than their leaded equivalents, and this combined with the saving in PCB area by not having so many holes (which are now used mainly for plated-through connections), plus the ability to have components on both sides of the PCB, can result in rather denser and more compact boards.

To ensure that the SMT parts are securely attached to the PCB mechanically, they are generally cemented to it using an epoxy resin adhesive. This is applied to the PCB in tiny blobs just before each component is mounted in place, usually by a "dispensing head" on the same automatic *pick and place* machine (but sometimes by a different machine which applies the adhesive just before the board passes to the pick and placer).

Generally the soldered connections between SMT components and the PCB copper are made by *reflow soldering*. With this technique, small solder pads are applied to the PCB copper pattern in each position where a joint is to be made, before the components themselves are mounted. The solder is actually applied as a paste, using a screen printing technique.

Then after the components have been mounted by the pick and placer, the complete assembly is passed through a "reflow" station which heats up the copper pattern and component pads/leads, to melt the solder paste and convert it into solder metal to make the connections (Fig.2). In some cases the boards are passed through a chamber radiating them with ultra-violet light before reflow soldering, to ensure that the epoxy adhesive is properly "cured".

Two main techniques are used for reflow soldering. One is *vapour phase* reflow, where the boards are lowered into a vat of fluorocarbon vapour heated to about 215°C; the hot vapour rapidly heats everything up, and melts the solder.

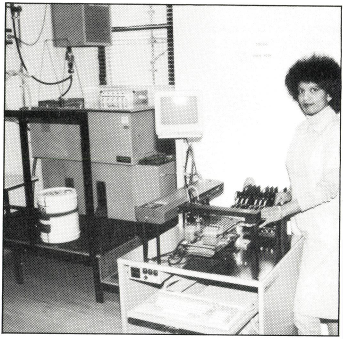
The alternative reflow technique is infra-red (IR) heating, where the board assembly passes through a series of zones where it is subjected to heating by IR energy, and again brought to a temperature where the solder melts.

Early IR reflow stations used short-wave IR energy, which was less successful than vapour-phase reflow because it suffered from "shadowing" by component bodies, and also caused overheating of parts whose bodies were of certain colours. The latest IR reflow stations use long-wave IR energy, which overcomes these problems. Because of this, IR reflow seems to be becoming the favoured technique for SMT, because it allows better control of the temperature *profile* for the heating process.

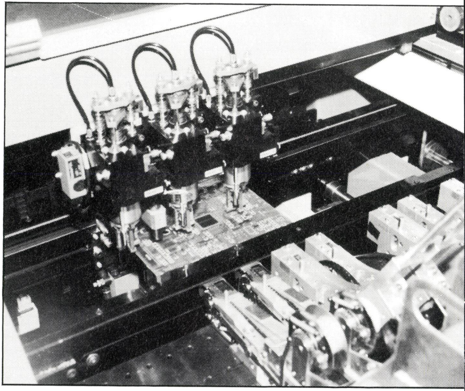
Many chip components can be damaged internally if they are subjected to a temperature rising faster than about 2-4° per second. Similarly many ICs can be damaged if their internal (chip) temperature rises to above 180°C. Large PLCC packages themselves can also be damaged if kept at the peak reflow temperature of 215° for longer than about 20 seconds.

It is not easy to adjust the temperature profile of vapour phase reflow soldering to meet these requirements, but this is somewhat easier with long-wave IR reflow soldering.

Conventional wave-soldering machines can also be used for SMT. In fact this is generally the preferred approach when surface mounted parts and leaded components are mixed on the same board, as reflow soldering tends to be unsuitable for leaded components. Probably the type of wave soldering best suited for SMT is that using a hollow wave, where the Bernoulli effect ensures that the solder flows uniformly around the bodies of SMT components.



Telectronics Cordis uses a Mamiya ECM85 "Superhand" pick and placer to assemble some of its implanted products.



The Yamaha YM 4600S pick and placer can be fitted with up to 3 heads as shown here, and both tube and reel type feeders.

have a lot of experience with automatic insertion machines and production programming", he added.

General Power Controls has an impressive SMT lineup, with a Mitani MSA5000 solder paste screen printer, three Yamaha pick and placers, and a Yamaha YM3000 IR reflow station with UV curing option.

Mr Morris said he's convinced they made the right decision to go with IR reflow soldering. Before making the decision he sought advice from contacts in experienced firms in the USA, and this paid off. The results with IR reflow have been excellent.

Overall, Mr Morris said he was "very excited" about the potential of the Mitani/Yamaha SMT equipment. His company is moving now into higher technology 6-layer computer PCBs with 68 and 84-pin PLCC devices, and has signed a technology transfer agreement with US computer maker Digital Equipment to ensure that this further transition is made smoothly.

Well known 2-way radio maker Standard Communications has a single Yamaha YM4600S pick and placer at this stage, but has one of the larger YM6000S machines on order. The company's MD Ted Dunn told me that they're generally very happy with the performance of the YM4600S and the productivity levels achieved with automated SMT assembly. When the second machine is installed he anticipates that they'll be able to achieve a production level of around 30,000 two-way radios per year, with each radio board having about 250 components.

Asked if his production people had encountered any problems in moving to SMT, Mr Dunn said they were a little disappointed that SMT machinery typically had around 20% downtime. This is necessary not only for maintenance but also to reload for different production runs.

In an effort to improve this figure, his company is working on reducing the number of different components used in all products – to reduce reloading time. In fact they're confident of reducing the component count to only 60 different parts for all models, which would virtually eliminate reloading time and reduce downtime to the maintenance level.

About the only other negative point raised by Mr Dunn was a general one about PCBs and wave soldering, rather than SMT as such. Apparently his company has found that PCBs sourced from overseas and carried in by air freight can "explode" during wave soldering, due to trapped moisture. Standard Communications has therefore found it necessary to insist that such boards are packed in moisture-proof packaging, before despatch.

Other than that, Standard Communications seems to be making the transition to SMT very smoothly.

Sydney-based medical electronics manufacturer Telectronics has been using a Mamiya ECM-8300 pick-and-placer for some time, to assemble boards for its world famous heart pacemakers, defibrillators and pacemaker programmers. Manufacturing engineer Albert Shen says they're very happy with the Mamiya machine, which he regards as well suited for the needs of small to medium sized manufacturers. Using it to move into SMT has enabled Telectronics to significantly reduce the size of its implantable devices, while at the same time making them "smarter".

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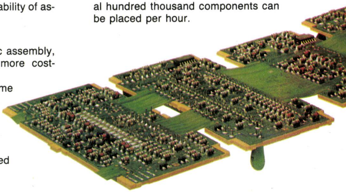
- Because there are no longer any connecting wires and drill holes, factors which used to cause errors such as offline drilling due to inaccurate reference points, are now things of the past.
- Impact and vibration resistance is considerably better.
- Soldering is more precise; reliability of assembly is improved.

SMDs are more cost-effective

- Thanks to fast, fully automatic assembly, SMDs are up to 10 times more cost-effective.
- No longer the one-step-at-a-time process of manual assembly.
- SMDs create new technical and economic opportunities thanks to the facility for problem-free mixed assembly with wired components.

SMDs are easier to manufacture.

- SMDs can be mounted on printed circuit boards of all kinds: on ceramic substrates, film circuitry, phenol resin bonded paper, epoxy glass cloth and plastic boards with copper conducting paths.
- SMDs can be mounted using all currently popular soldering methods.
- Assembly can be performed sequentially, or simultaneously or by pick-and-place method using tapes. A maximum of several hundred thousand components can be placed per hour.



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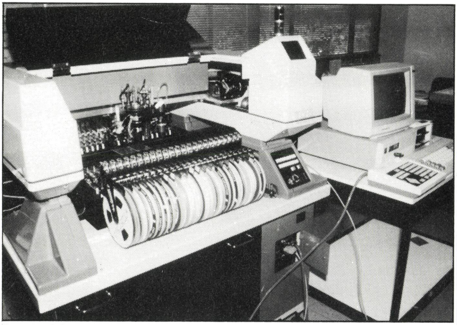
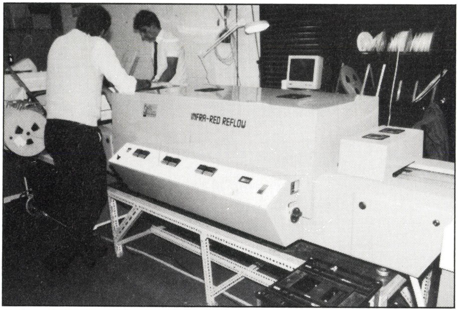


Standard Communications is using a Yamaha YM 4600S pick and placer at present, with a PC for preparing and loading in the programs.



A view of the Manix/Surf Systems IR-150 long wave IR reflow system being used at Tytel, located in Artarmon in Sydney.

reliability are extremely important for equipment like pacemakers that is implanted in the human body. Because of this I made a point of asking Mr Shen if he was happy with this aspect of SMT and the Mamiya machine, compared with the previous manual assembly.

"In general, I am." he said, "Certainly the Mamiya machine gives us consistently high quality results, but we do follow a rigorous preventative maintenance program to make sure that this happens. We have also spent considerable effort in designing the boards for our new products, to ensure that they allow us to get the best results from surface mount technology."

Telectronics currently uses both wave soldering and reflow soldering, for different types of boards. It has a Manix IR-300 long-wave IR reflow system on order.

Manual SMT

The evolution of smaller and more economical automated SMT machinery has certainly allowed many more medium-sized companies to move into SMT. But what about the companies that are even smaller, and can't justify even the cost of small automatic machinery?

Luckily there have also been worthwhile developments in the area of manual and semi-automated SMT equipment, again in the last year or so. These have seen the release of a number of machines, priced significantly below even the cheapest automated gear, but which allow a surprising amount of SMT assembly work to be done quite easily.

This kind of equipment is in fact very flexible. It can be used for small-scale production, for rework and repair of SMT equipment in either production or servicing environments, or for assembling pre-production prototypes. This can make it equally attractive to either the small company wishing to get into SMT with the lowest possible investment, or to the large manufacturer not wishing to disrupt a production line in order to make up prototypes.

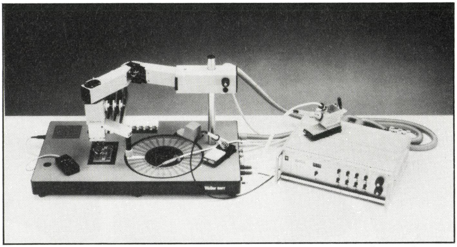
R & D laboratories can also use this kind of equipment for the same purpose, of course.

An excellent example of this new generation of manual SMT equipment is the Weller PPS Pick-Place-Solder System, made in Germany by the international Cooper Tools Group.

Bob Crabbe, director of marketing for Weller distributor the George Brown Group, told me that his firm had sold about 10 of the PPS systems in Australia at the time of writing. Many of them have been sold to large companies like Thorn and British Aerospace, for work on prototypes.

The PPS system consists of a table-top workstation with a very stable base and manually controlled manipulator arm. This has a vacuum needle head, for selecting chip parts from either a "carousel" tray which sits in the base, or conventional parts feeder racks which can be clipped into the rear. The carousel tray rotates segment by segment in either direction, under the control of a remote control handpiece – which also controls head vacuum and other main functions.

The PCB to be assembled or repaired on the PPS sits on a heating plate, whose temperature is controlled at any desired level up to 300°C. This is to provide preheating. Heating for the actual soldering or desoldering is provided by angled nozzles on each side of the vacuum needle head itself, which direct streams of hot inert gas on either side of the chip part directly beneath the vacuum needle. The PPS thus has a



The Weller PPS manual pick-place-solder system, which allows fast and accurate SMT assembly plus hot gas reflow soldering/desoldering.

built-in form of vapour-phase reflow soldering/desoldering, with gas temperature and flow both accurately controlled via the companion control unit. On-off control of the soldering is again via the remote control handset.

To apply solder paste to the board pads there is a separate hand-held dispenser, with actual paste dispensing again controlled by a button on the remote controller. The dispenser can also be used for epoxy adhesive.

In short, the PPS system really provides all of the facilities needed for accurate and consistent SMT work, under manual control but with a high level of machine support.

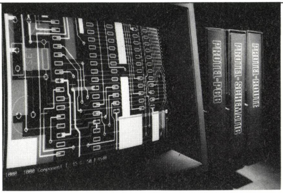
The basic Weller PPS system sells for around $22,000 – which as George Brown's Bob Crabbe points out, is around half of the lowest-cost automatic pick and place machine. Not bad at all when you consider that it also includes inbuilt reflow soldering and solder paste/epoxy dispenser!

Small wonder that Bob Crabbe believes the PPS is exceptionally well suited for the needs of many of Australia's smaller manufacturers, with relatively small budgets and production runs. It would certainly seem so, and I suspect he's going to sell quite a few more in the forthcoming months.

All in all then, the growth of these new smaller scale and lower-cost SMT production machines over the last 12 months or so looks very promising for Australia's smaller electronics manufacturers. Now there *is* a way to compete with overseas manufacturers using the latest production technology, and without breaking the bank!

Further information on the Yamaha and Mamiya ranges of SMT production equipment, and also Manix reflow soldering equipment, is available from Hawker Richardson Mechatronics Division, at Unit B, 3-7 Highgate Street, Auburn 2144; phone (02) 748 3511, or (03) 20 2461.

Similarly further information on Weller SMT production and soldering equipment is available from George Brown Group, 174 Parramatta Road, Camperdown 2050; phone (02) 519 5855, or (03) 329 7500.



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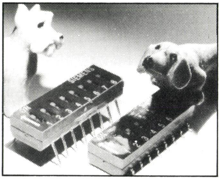
Surface mount update:

New products for SMT



DIP switch for SMT

Siemens has devised a new single-pole on/off DIP switch, in plug-in and surface-mountable (SMD) versions, which can be immersion-washed and automatically equipped. The SMD version features gull-wing tails. Longer spacer tails are additionally fitted to the plug-in version to keep the component clear of varpours which develop during soldering.

The switch is only 5mm high. It is designed with a centre spacing of 2.54mm and has a service life of 5000 switching cycles. The contact elements are plated with gold over nickel and feature self-wiping contacts. The tails are tinned by electro-plating to increase shelf-life and ensure problem-free soldering.

A trough-shaped, sealed housing and transparent self-adhesive foil protecting the upper side of the cover mean that the switch can be completely immersed for washing. The switch is currently available only in an 8-section version, but other variants are due to follow.

Further details from Siemens, 544 Church Street, Richmond 3121, or phone (03) 420 711.

SMD TransZorbs

General Semiconductor Industries has available a range of TransZorb transient suppression devices, in surface-mount packages. The SMC series is rated at 1500W peak power, with voltage ratings from 5.0 to 170.0 volts, while the SMB series is rated at 600W peak power and is available in the same voltage ranges.

Both series of devices are unidirectional, and are suitable for protecting many different kinds of electronic circuitry from damage due to overvoltage transients. Clamping action is claimed to be extremely fast – in the order of one picosecond. The devices can be supplied in either gull-wing or J-leaded packages.

Further information from Electronics and Semiconductor Distributors, 17 Russell Street, Essendon 3040 or 'phone (03) 370 5522.

Bonding, coating compounds

Loctite Australia has available a wide range of chemical compounds for chip component bonding, conformally coating and sealing PC board assemblies.

Chipbonder 346 formulation offers excellent thermal conductivity and is designed for syringe or pin transfer application. It offers fast curing by heat or UV light.

Chipbonder 347 is a low viscosity formulation suitable to screen printing and pin transfer, where precision dot placement is required.

Chipbonder 360 is a general purpose formulation designed for syringe dispensing.

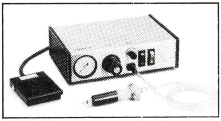
All three formulations are available in a variety of packaging to suit most common models of applicator head and pick-and-place machine.

Shadowcure 360 is a UV-curing conformal coating formulation which prolongs board life by protecting sensitive components from moisture, mildew and solvents. Unlike earlier UV coatings it requires no heat for total polymerisation, which occurs in less than 60 seconds of UV irradiation.

Impruv 365 is a sealant/adhesive which can be used for bonding, sealing, potting, strain relief, tamper proofing and insulating contacts. It withstands thermal cycling and temperatures to 300°F.

The Tak Pak adhesive system is an adhesive/accelerator combination designed for optimum fixing of components to PC boards. It provides bonding in 15 seconds, as is said to provide the fastest and most cost-effective wiring and component tie-down system available.

Further information on these and many other chemical products with applications in electronics from Loctite Australia, 56-58 Alexander Avenue, Taren Point 2229 or 'phone (02) 525 8366.



Manual SMT tools

The 1000VAC Vacuum Pick-up Tool from EFD simplifies pick-up and placement of surface-mount parts and chips, gemstones or other small components. Workshop air input at 20 – 100psi is converted by an internal venturi pump into vacuum, adjustable up to 16″ of mercury.

Three sizes of stainless needles are provided, with five molded tip pads to ensure proper handling of various size parts. To activate the vacuum, the operator simply covers a small hole in the tool handle with the forefinger. Uncovering the hole effectively stops the vacuum and releases the component.

Also available is the EFD 1000D Automatic dispenser, which provides controllable repetitive dispensing of all medium to high viscosity industrial liquids like solder pastes, epoxy adhesive, silicones, paste inks, fluxes, brazing pastes and many kinds of lubricants. The 1000D allows full control of deposit size, by means of both pressure and duration adjustment of activating air pulses. Pulse triggering is via a foot pedal.

Further information on both products is available from Electronic Development Sales, 92 Chandos Street, St Leonards 2065 or 'phone (02) 438 2500.

SMT workshops

Royston Electronics will be holding week-long practical workshops covering the whole field of surface mounting technology, in both Sydney and Melbourne during September. The workshops will be conducted by Mr Joe Keller, well-known in the US electronics industry as an expert consultant and teacher in this field.

The workshops will be limited to 50 persons each. At the end of the workshop participants should be fully qualified to direct the implementation of SMT within their respective companies or organisations. The fee for attending the workshop will be $650, of which a deposit of $250 is required upon application with the balance payable on the first day. Workshop dates are 12-16 September in Sydney, and 19-23 September in Melbourne. Venues will be announced nearer those dates.

Applications and enquiries should be directed to Tony Madison on (02) 647 1533 or Philip Glover on (03) 543 5122.

Chip components

The RX21 series of chip resistors from Murata is manufactured in the newer and more compact EIA 0805 package size, measuring 2.0 x 1.25 x 0.55mm.

The resistors are highly stable and reliable metal glaze components, paste printed on a high purity alumina substrate and fully sealed with glass. They have a temperature coefficient of +/-200ppm/°C and are capable of dissipating 1/8 watt at 100 volts. Solderability is enhanced by nickel secondary electrodes and an external electrode coating of solder to improve wetting.

Available in E12 series values from 100 ohms to 1M, the RX21 series are supplied in either tape or reel format.

Also available from Murata is the new DD400 series of semiconductor capacitors, offering good frequency characteristics, low loss, low distortion and no piezoelectric effect. This makes them very suitable for replacement of polyester film capacitors in audio applications, and for general bypass and coupling applications.

The new capacitors are of the strontium titanate boundary layer type and feature a thinner dielectric, giving approximately 50% greater capacitance for a given physical size. They have paste printed and baked aluminium electrodes, to avoid migration problems associated with silver electrodes.

The DD400 series is available in values from 1nF to 0.1uF with a 25 volt rating. They are supplied on lead tape and ammo box or lead tape and reel, and 500 piece bulk packs.

Further information on these and other Murata SMDs from IRH Components, 32 Parramatta Road, Lidcombe 2141 or 'phone (02) 648 5455.

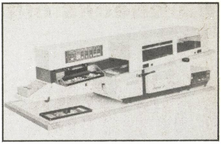
Soldering station

The Weller Heat-a-Print is a very flexible benchtop soldering station designed for manual assembly or rework of surface-mount boards. It provides a heated working surface for substrate preheat, with controlled working temperature continuously adjustable from 30 – 200°C (using a digital temperature readout).

Also provided is a micro-soldering pencil, again with controlled and fully adjustable working temperature (50 – 450°C).

Area of the heated working sheet surface is 85 x 55mm, and the heated surface is raised from the bench by a 45mm high ventilated stainless steel frame.

Further information is available from George Brown Group branches, or 'phone (02) 519 5855.



Kirsten jet-wave soldering systems

The well-known and time proven Kirsten range of jet-wave soldering systems is now available in Australia from Hawker Richardson. Made in Switzerland by Kirsten Kabeltechnik AG, the systems use a patented hollow soldering wave which is claimed to be especially suited for soldering surface-mounted components due to enhanced Bernoulli flow around them. The machines also use a patented solder pumping system in which the solder itself is the only moving part, for greatly improved reliability and faster speed of response.

New models in the Kirsten range provide greater flexibility in production flow. Auto-return systems offer single and double pass options, carousel systems provide continuous flow and/or return, while in-line conveyor systems integrate with fully automated transport systems.

Kirsten also offers an IR reflow soldering system.

Further information is available from Hawker Richardson Mechatronics Division, Unit B, 3-7 Highgate Street, Auburn 2144; phone (02) 748 3511 or (03) 20 2461.

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EA checks out the latest

FM/AM-1200S Comms Service Monitor

For efficient servicing and adjustment of radio communications equipment, you really need a good RF signal generator, an oscilloscope, a power/modulation – frequency/signal meter, a spectrum analyser – and nowadays a calibrated multimode receiver and an audio function generator as well. Here they all are, in one compact and portable case!

by JIM ROWE

About eight months ago in these columns, I reviewed the latest model A-8000 Spectrum Analyser from respected US maker of RF test equipment IFR Systems. It was very impressive indeed, and I really enjoyed putting it through its paces.

Just a few weeks ago the local IFR distributor Vicom Australia contacted me again, and asked if I would like to check out the latest version of another of the company's RF instruments: the FM/AM-1200S Communications Service Monitor. Needless to say I didn't need a great deal of persuasion, and so it was that Vicom's NSW sales manager Alan Marsden dropped one in a couple of days later.

I must confess the label *Communications Service Monitor* hadn't meant a great deal to me, before I saw it in the "flesh". It was only then I realised that I had undoubtedly seen earlier versions of the FM/AM-1200S on benches in various labs and service workshops, mainly in companies working with RF communications gear. Until now there had never been the opportunity to examine one closely, but that time had obviously arrived.

When you first see the instrument there seem to be quite a few controls on the front panel, as you can see from the photos. But the more you become familiar with it, and aware of just what it can do, the more you find yourself getting surprised that there aren't a lot more knobs!

The fact is that inside that relatively compact case, you've got virtually a complete RF testing lab. There's a synthesised RF signal generator, an oscilloscope, a power/modulation/frequency/-signal strength meter, a calibrated multi-mode HF/VHF/UHF communications receiver, a programmable audio function generator and a wide-range spectrum analyser – all microprocessor controlled and capable of running from either inbuilt batteries or the AC mains.

And of course all of those instruments make use of the latest technology, to achieve very high levels of performance indeed. Here's a quick tour of the specs:

The FM/AM-1200S synthesised RF signal generator section can generate modulated or unmodulated signals anywhere between 250kHz and 999.9999MHz, variable in 100Hz steps when the frequency is locked (which is the case normally). Interpolation and infinite adjustment are possible by deliberately switching the synthesiser out of lock, allowing a continuous variation of +/- 10kHz.

In the normal locked condition, frequency accuracy and stability are basically that of the master TCXO (temperature compensated crystal oscillator), which is normally 0.2ppm – but there is an optional oven oscillator which can improve this to .05ppm. RF output level of the generator section is adjustable from -20dBm down to -127dBm into 50 ohms, via an 11 stage 10dB-step attenuator and concentric 11dB-range variable attenuator.

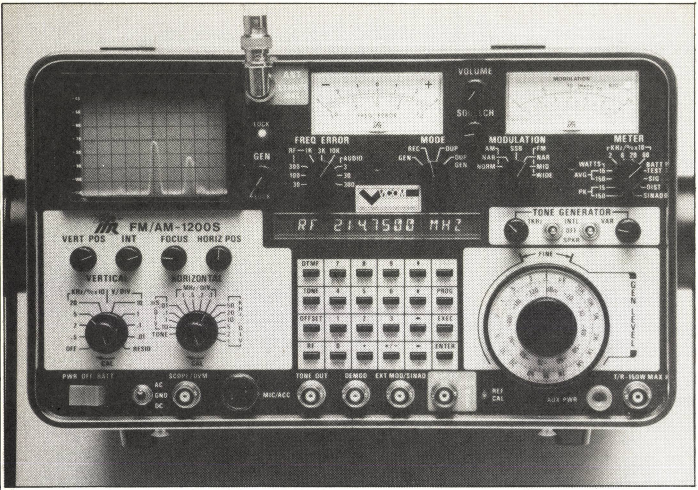
For internal modulation, the RF generator can be fed with any of the signals produced by the inbuilt audio function generator. This produces either a fixed 1kHz tone derived from the master TCXO, or a signal variable between 10Hz and 30kHz in 0.1Hz increments. It can produce sine, square, ramp or triangle waveforms, pulses, programmable DTMF bursts for dialling, even pulse codes for digitally coded squelch.

These signals may be used for either amplitude or frequency modulation of the main RF generator, and the same choices are available for external modulation. As well as a BNC connector for external modulation input there's also a standard keyed microphone input socket.

The communications receiver section of the FM/AM-1200S is tuned using the same keyboard as the generator, and covers the same HF/VHF/UHF frequency range (250kHz – 999.9999kHz). It uses triple conversion and has a basic sensitivity of 2uV, with the ability to demodulate AM, SSB and FM signals. There are two IF bandwidth settings for AM and three for FM, to optimise reception in all normally used modes. Signals may be received either "off air" via an antenna connector, or direct from a transceiver via a T/R connector.

Associated with the receiver section are metering circuits which can be used to measure signal strength, input power, modulation depth, RF and modulation frequency errors, SINAD, and if the latest cellular radio option is fitted, SAT frequencies and deviation. By the way most of these parameters can be read in either analog or digital fashion, as desired.

The power measuring circuitry provides both 0 – 15W and 0 – 150W ranges, with both peak or average readings available. Accuracy is +/- 7% of



A closeup of the front panel, with the screen showing the sound carriers for Sydney TV station TEN-10.

reading +/- 3% of FSD from 1 to 600MHz, and +/- 20% of reading +/- 3% of FSD from 600MHz to 1GHz. The internal dummy load can cope with 50W continuously, or 150W for a duty cycle of 1 minute on / 5 minutes off.

Six ranges are provided for RF frequency error, with ranges of +/- 10kHz down to +/- 30Hz in 3:1 ratios. The lowest of these ranges has 1Hz resolution, while overall accuracy is that of the master TCXO +/- 3% of FSD. Three further ranges allow measurement of modulation frequency accuracy from 10Hz to 12kHz, with an accuracy of +/- .01% +/- 6% of FSD (FSD's are +/- 300Hz, 30Hz and 3Hz).

The modulation metering section provides four ranges for FM deviation and two for AM modulation depth, each with an accuracy of +/- 5% of reading +/- 3% of FSD for a 1kHz tone. The FM ranges measure 60kHz, 20kHz, 6kHz and 2kHz FSD, while the AM ranges read 60% and 200% FSD respectively.

The SINAD and distortion ranges allow measurement of SINAD from 3 to 20dB and distortion from 0 to 20%, both at 1kHz. Input level may be from 250mV to 2V RMS, with an input impedance of 10k.

Normally the RF generator and receiver sections are used alternatively, sharing the common programmed frequency. However for testing duplex equipment they can be operated simultaneously, with the generator frequency offset from that of the receiver by any desired amount up to +/- 49.99MHz in 10kHz steps.

The spectrum analyser section of the FM/AM-1200S is not quite as fancy as IFR's separate A-8000 instrument as reviewed last November, but is still very flexible. Unlike that in the A-8000 it can also be operated at the same time as the receiver – a very handy bonus. The centre of the analyser display is always phase-locked to the programmed centre frequency of the receiver, making it very easy to identify displayed signals at a glance.

Effective analyser range is 1 to 1000MHz, with 10 calibrated scanning widths from 1MHz/division down to 1kHz/division. Each dispersion setting has its own fixed bandwidth, selected to give optimum performance for most applications.

Sharing the same 64 x 51mm CRT display as the spectrum analyser is the FM/AM-1200S's scope section, which although not fancy is nevertheless quite adequate for most communications work. It has a vertical bandwidth of DC – 1MHz, with a sensitivity of 10mV/division switchable in decades down to 10V/division but with a variable control for interpolation. Timebase ranges are 10ms/div to 10us/div, again in four decade ranges with a variable control.

Additional "custom" ranges on the scope allow for viewing and measurement of either the AM or FM modulation on received carriers, for checking limiting and distortion, and also residual distortion and noise.

As you can see from this rundown, the basic instrument provides just about all of the facilities you could want for the majority of testing and even development work on RF communications gear. But if that wasn't enough, IFR now also provides a number of options which can be used to enhance its flexibility further again.

For example there's a "tracking generator" option, which provides a sweep generator output locked to the FM/AM-1200s spectrum analyser scanning. This allows you to analyse the frequency/response curves of filters, amplifiers, diplexers or whatever. As noted earlier there's now also a cellular radio testing option, which allows automatic spectrum analysis testing (SAT) of cellular radio telephone equipment.

So much for the instrument's specs, which are certainly very impressive in themselves. But what's it like to drive?

Very nice indeed, and a far cry from those earlier generations of RF test gear where you could never be really sure about the accuracy or reliability of anything very much.

There's no doubt about it, the FM/AM-1200S is hands-on proof that RF test equipment has come an awfully long way in the last 15-odd years. Engineers who worked on radio and TV gear back in the 1960's would have given their eye teeth to have one of these phase-locked and microprocessor controlled beauties, make no mistake.

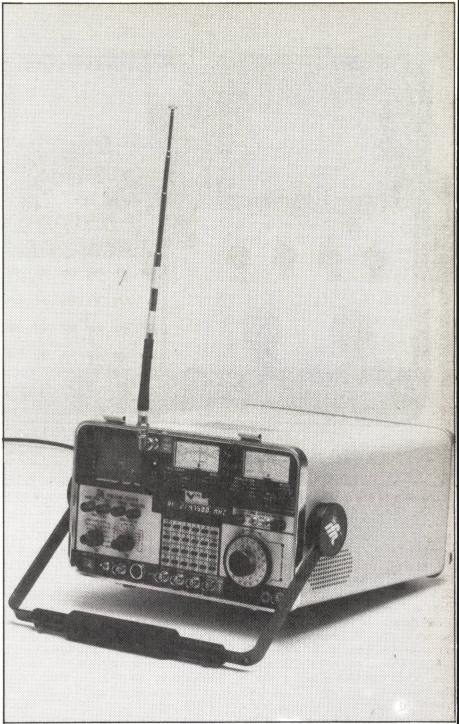
Punch up a frequency and there it is, wherever you will – coming out of the generator, being monitored by the receiver, or slap bang in the middle of the analyser scan. Flick a switch or two and you can resolve almost any kind of modulation or measure almost any parameter you need. No sweat, no strain and with a very high level of reproduceability. RF measurements as we've always wanted to be able to make 'em.

Mind you, there is no way I could easily check its accuracy to any great precision – we really don't have any equipment capable of doing this, alas. However I was able to get a rough idea, by punching up frequencies for known reference signals, such as the local TV channel sound carriers and various standard frequency transmissions. They were all there as expected, and the frequency error readings obtained were quite consistent with the rated specs of the FM/AM-1200S. 'Nuff said, I think.

In fact what more can I say? It's an extremely powerful instrument, and capable of making a very wide range of measurements on radio communications equipment and systems, at a level that must surely represent the current state of the art.

Now for the sobering news: the basic FM/AM-1200S with spectrum analyser has a price tag of $18,356. The tracking generator option if you desire it costs a further $1827, while the .05ppm oven-housed master oscillator option costs $1439. Not a problem for companies and other organisations, to be sure, but still outside the range of hobbyists and covetous radio hams.

Further information on both this unit and the others in the IFR range is available from Vicom Australia, which has offices in Sydney, Melbourne, Brisbane and Wellington. The Sydney phone number is (02) 957 2766, while that in Melbourne is (03) 690 9399.



An overall view of the FM/AM-1200S, with the matching telecopic whip antenna plugged into the antenna input for general "sniffing around". As noted in the text, the instrument is virtually a complete communications tester with synthesised signal generator, CRO, spectrum analyser, receiver and signal analyser. Despite this it's very easy to use – just punch in the frequency of interest, and there you are...

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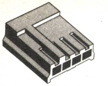

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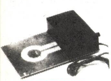

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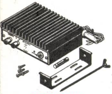

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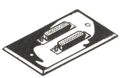

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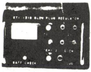

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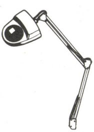

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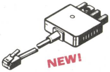

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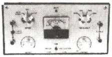

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Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder.
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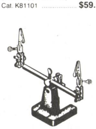

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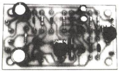

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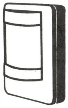

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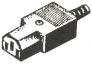

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World Time Signals & how to use them

by IAN POGSON

With the closure of the standard frequency and time signal service from VNG in Lyndhurst, Victoria, many users of this valued service were obliged to look elsewhere for a time and frequency reference. Here, we look at a number of possible alternatives for this region.

Earlier on when I was preparing material for this article, there were reports that VNG was likely to close in the not to distant future. Indeed, one report had it that this was possibly around April 1988. However, events quickened and with only a couple of days notice, the service was terminated on the last day of September 1987.

For a few weeks there was a great void, but happily the Royal Australian Navy took up the challenge and put on the air what they term 'an intermediate accuracy time signal'. More about that a little later on.

After making a lengthy study of those standard frequency and time transmissions useful in our region, I find it rather surprising that there are only a few which we are able to make use of. My list, shown in Table 1, includes the new Royal Australian Navy (Belconnen), RWM (Moscow), RID (Irkutsk), WWV (Fort Collins), WWVH (Kauai), JJY (Koganei) and CHU (Ottawa).

Of the many stations listed in various books and publications, the above list is rather modest. However, even without the Royal Australian Navy signals, there are usually a few others available on one frequency or another, according to the time of day and other factors.

Before going into the list in greater detail, no doubt many readers would ask the question, what about the local broadcast stations' time signals? One major disadvantage is that a time signal is only available once each hour. Another point is one of accuracy.

The ABC and some commercial stations emit a signal which is reasonably consistent and within about 20 or 30ms of the precise time. 2CH in Sydney has been checked and found to be about half a second fast! But this is beaten by 2KY. I have found their time signals to be variable and on one occasion at least, it was about one and a half seconds fast! It begs the question, where do these time signals come from?

If you only wish to catch a train or bus, then these signals would be good enough. But for anything more serious, we must stay with the dedicated time and frequency signals.

Before investigating possible overseas standard time and frequency signals, let us take a closer look at the new service provided by the Royal Australian Navy, with transmitters located at Belconnen, a suburb of Canberra.

This is a time signal service only, using 10kW transmitters on 6.448 and 12.982MHz, USB suppressed carrier. Seconds pulses are derived from a caesium beam standard, with an accuracy of 1×10^{-11}. There is a lag with respect to UTC of 36 microseconds. The seconds pulses consist of bursts from a 1kHz source.

The minute code sequence consists of one long pulse of approximately 450ms, marking the minute. Then all seconds pulses up to 55 are of approximately 35ms duration. Seconds 56 to 59 are short pulses of approximately 12ms each. The hour code sequence is such that the hour is marked by three 450ms pulses and the half hour is marked by two 450ms pulses.

I understand that the RAN regards these transmissions as of less than top priority, but I also get the impression that the service is taken seriously and will be continued under normal circumstances.

If we wish to obtain time readings with the greatest possible accuracy, we must take into account the time taken for the signal to travel from the point of transmission to the reception point. This time can be anything from a millisecond or so, up to tens of milliseconds. Some figures are given in the table between the point of transmission and Sydney.

Providing the coordinates of the points of transmission and reception are known, the distance can be calculated and from that the time lag can also be determined. I have given three examples of these calculations so that these may be used as a guide for other calculations which need to be made.

The following conventions and symbols are used for our calculations:

N latitudes are +ve
S latitudes are -ve
W longitudes are +ve
E longitudes are -ve
L_A = latitude of your location
L_B = latitude of other location
Lo_A = longitude of your location
Lo_B = longitude of other location
P = the difference in longitude between locations
D = distance in nautical miles
D x 1.151 = distance in statute miles
D x 1.8522 = distance in kilometres

(Coordinates should be converted to degrees and decimals of degrees for calculator use).

To put the above information to practical use we have the equation:

$$D = -60\cos^{-1}(\cos L_A . \cos L_B . \cos P + \sin L_A . \sin L_B)$$

Example 1: To find the great circle distance from the RAN transmitter (Belconnen) to Sydney.

Take coordinates of each location:

Sydney $L_A = -33°55' = -33.92°$
$Lo_A = -151°10' = 151.17°$
Belconnen $L_B = -35°15' = -35.25°$
$Lo_B = -149°8' = -149.13°$

$$\begin{aligned} P &= Lo_A - Lo_B \\ &= 151.17° - 149.13° \\ &= 2.04° \end{aligned}$$

Taking sine and cosine:

$\sin L_A = -0.5580$ $\cos L_A = 0.8298$
$\sin L_B = -0.5771$ $\cos L_B = 0.8166$
$\cos P = 0.9993$

$$\begin{aligned} D &= 60 \cos^{-1} \\ &\quad (0.8298)(0.8166)(0.9993) + (-0.5580)(-0.5771) \\ &= 60 \cos^{-1} (0.6771 + 0.3220) \\ &= 60 \cos^{-1} (0.9991) \\ &= 60 \times 2.431 \end{aligned}$$

= 146 nautical miles
or, 146 x 1.151
= 168 statute miles
or, 146 x 1.8522
= 270 kilometres

Example 2: Moscow to Sydney

Sydney L_A = -33°55′ = -33.92°
Lo_A = -151°10′ = -151.17°
Moscow L_B = 55°45′ = 55.75°
Lo_B = -37°18′ = -37.3°
P = 151.17° - 37.3°
= 113.87°

Taking sine and cosine:

sin L_A = -0.5580 cos L_A = 0.8298
sin L_B = 0.8236 cos L_B = 0.5628
cos P = -0.4047
D = 60 $\cos^{-1}$ (0.8298)(0.5628)(-0.4047) + (-0.5580)(0.8036)
= 60 $\cos^{-1}$(-0.1890 - 0.4596)
= 60 $\cos^{-1}$(-0.6486)
= 60 x 130.44
= 7826 nautical miles
= 9008 statute miles
= 14495 kilometres

Example 3: Kauai, Hawaii to Sydney

So far, our calculations have involved only locations between the Greenwich meridian and the international date line. In this example, we have locations on either side of the date line. The important point to remember is that we are interested in longitudinal difference between the two points.

Sydney L_A = -33.92° Lo_A = -151.17°
Kauai L_B = 21.98° Lo_B = 159.77°
Now, P = (180° - 151.17°) + (180° - 159.77°)
= 28.83° + 20.23°
= 49.06°

Taking sine and cosine:

sin L_A = -0.5880 cos L_A = 0.8298
sin L_B = 0.3742 cos L_B = 0.9273
cos P = 0.6552
D = 60 $\cos^{-1}$ (0.8298)(0.9273)(0.6552)+ (-0.5880)(0.3742)
= 60 $\cos^{-1}$(0.5041 - 0.2088)
= 60 $\cos^{-1}$(0.2953)
= 60 x 72.82
= 4369 nautical miles
= 5029 statute miles
= 8092 kilometres

Having made the distance calculations, we are now in a position to determine the transmission time delay in each case. If we are looking for the greatest possible accuracy, the distances calculated are for travel along the Earth's surface – and this only applies to very short distances, where the transmission is via the ground wave. So we must consider ionospheric reflections.

Shortwave propagation takes place in the form of 'hops' from the point of transmission, via upper atmosphere layers. This increases the distance travelled and affects the transmission time accordingly.

For short distances up to about 2400km and in daylight, the E layer can sometimes give good stable propagation. The virtual height of the E layer is about 125km and this mode applies to one hop only.

The F2 layer is the one which influences the great majority of shortwave signals. The height of the F2 layer varies between 250 and 450km due to night and day, the seasons and other factors. The average height may be reckoned to be 350km for our calculations.

In order to facilitate calculations via the reflecting layers just mentioned, A.H. Morgan in his *Time Synchronisation of Widely Separated Clocks* suggests the use of a graph for the specific purpose. I have found this graph to be very useful in these calculations, and it is reproduced here for use in our present calculations and any others which readers may wish to make.

The maximum distance per hop via the F2 layer is about 4000km. Use of the graph up to about 4000km implies that only one hop is involved and use of the graph is straightforward. However, where greater distances are involved, the minimum integral number of hops should be assumed, up to the maximum of 4000km.

In example 2 we found the distance from Moscow to Sydney to be 14495km. This would involve four hops of 3624km each. From the graph we have a delay of 12.5ms per hop, a total of 50ms.

Returning now to example 1, here we found that the great circle distance from RAN Belconnen to Sydney to be 270km. From this we can calculate readily the time delay for a ground wave situation. Given that the propagation velocity is 300,000km/second:

T = D/300,000

where T is in seconds and D in kilometres.

More conveniently,

t = D/300

where t is in milliseconds.

Therefore,

t = 270/300
= 0.9 milliseconds

As the distance is beyond ground wave propagation, we must look at layer reflections. Being less than 2400km, reflection could be via the E layer in daylight, or the F2 layer – even a combination of both. Referring to the graph we find that for 270km and from the E layer, we have a delay of 1.2ms. From the F2 layer it is 2.5ms. Which figure do we use?

STATION	LOCATION Latitude Longitude	FREQUENCY kHz	DISTANCE km from Sydney	DELAY mS average F2 layer
R.A.N. Belconnen	−35°15′ −149°8′	6448 12982	270	2.5
RWM Moscow	+55°45′ −37°18′	4996 9996 14996	14495	50
RID Irkutsk	+52°46′ −103°39′	15004 10004 15004	10826	37.5
WWV Fort Collins	+40°41′ +105°02′	5000 10000 15000	13438	46.8
WWVH Kauai	+21°59′ +159°46′	5000 10000 15000	8092	28.5
JJY Koganei	+35°42′ −139°31′	5000 8000 10000 15000	7950	27.4
CHU Ottawa	+45°18′ +75°45′	3330 7335 14670	16084	56

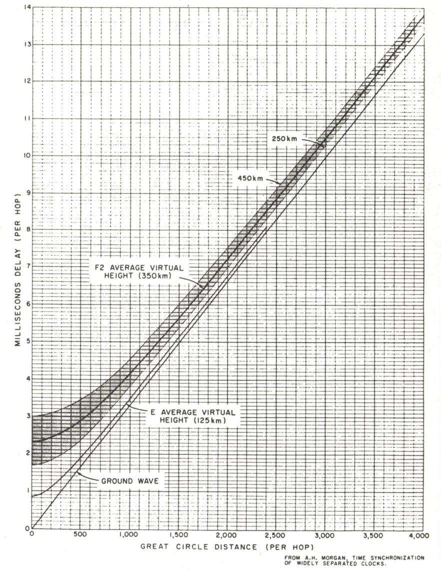
Table 1: The author's list of time signals which are currently available for use in Australia.

Answering this question is not easy. Where multi-mode propagation is likely to occur, careful study of the situation should give clues as to the best time of day when propagation is most stable and so the best time to make measurements. Where the distance is over 2400km this is not likely to arise.

My own experience so far with the RAN transmission as received in Sydney is that there is a noticeable variation in the delay time, amounting to a millisecond or more at times. This is a limitation which has to be lived with.

There are various techniques of obtaining more precise time, such as travelling clocks, TV synchronising pulse time transfer, etc. But we are confining our discussion here to the use of shortwave signals as being capable of giving accuracies of a few milliseconds and this method is fairly simple and cost effective.

It is a good idea to study as many of the time signals as possible, noting each one's characteristics and its usefulness in its ability to be resolved with accuracy. This can be determined after a while, with one or more signals emerging as the most useful. For what it is worth, here are some of my own experiences and observations.



FROM A.H. MORGAN, TIME SYNCHRONIZATION OF WIDELY SEPARATED CLOCKS.

A graph which shows delay time for signals reflecting from various layers of the ionosphere, versus hop distance. (A.H. Morgan).

When it comes to standard frequency and time signals, one usually thinks of WWV. My experience is that WWV is not very useful in the Sydney area, as it is usually too weak to get an accurate time check from it. On the other hand, WWVH is much stronger and more consistent.

There are two other signals which are of a comparable distance from Sydney – JJY (Japan) and BSF (Taiwan) – with respect to WWVH. Herein lies a serious problem when all three are coming in together. It becomes difficult, if not impossible, to sort out one from the other. However, when conditions allow, when only one of these signals is coming through, it can be very useful.

The above problem is one which is common where standard transmissions are made on the internationally allocated frequencies, such as 5, 10 and 15MHz. This point leads naturally to standard transmissions which are operating outside the normally allocated frequencies. We have already dealt with the new RAN transmissions. In addition, JJY also runs a service at night on 8.000MHz, which can be very useful. CHU in Ottawa is also worth checking.

Also, there are two Russian services which are strictly within the internationally allocated hands, being offset by 4kHz. RWM in Moscow radiates on 4.996, 9.996 and 14.996MHz. RID in Irkutsk radiates on 5.004, 10.004 and 15.004MHz. This amount of offset just nicely clears the main frequencies and

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each signal is conveniently out in the clear.

Whereas most standard transmissions on the shared frequencies are amplitude modulated seconds pulses, the Russians (and the new RAN transmissions) use what amounts to a keypad CW signal. I have found this mode much easier to resolve, giving a cleaner signal such that the seconds pulses may be determined more accurately.

On the debit side, the Russian transmissions are only available at certain parts of the day, according to seasons, etc., in common with many others. Also, they adopt a rotating sequence in that for the first eight minutes after the hour, RWM radiates an unmodulated carrier. Minutes 8-9 are silent and in minutes 9-10 the call sign is given in morse code. Minutes 10-20 the normal seconds pulses are radiated. Minutes 20-30, ten pulses per second are radiated with the second being emphasised. This sequence is repeated continuously.

RID is similar but it is offset from RWM. This sequential system does reduce the access time, but I have found both signals to be very useful.

The method of making use of the received seconds pulses will depend upon the degree of accuracy required. A clock may be set audibly and possibly visually with an accuracy of about 0.1 second at best. This may be good enough for many purposes.

Where greater accuracy is required, the locally generated seconds pulses may be compared with the received pulses on the screen of a CRO.

The local pulses are fed into the CRO so that they trigger the timebase of the CRO, set at say 10ms per division. The received signal is fed into the vertical amplifier with the gain set to give a suitable display.

The received pulse will only appear on the trace if it is no more than 100ms later than the triggering pulse. If this is not the case, then the local pulse needs to be adjusted so that it comes within the above limit. This done, then the amount of error may be determined.

Assuming that the CRO timebase settings are accurate, the time from the start of the trace to the start of the received pulse can be determined. This time must have subtracted from it the calculated delay of the arrival of the received pulse.

Suppose we are using RWM and the calculated delay is 50ms, and the received pulse appears at 45ms along the trace, then the local pulse is 5ms slow. If the received pulse appears at 60ms along the trace then the local pulse is 10ms fast.

Greater accuracy may be obtained by using a faster timebase where possible. Also, about 0.3 to 0.5ms may be allowed for delay added by the receiver itself.

Using these techniques, and cross checking between a number of transmissions over a period, I have been able to determine the actual time to less than one millisecond. It is possible to obtain greater accuracy by using refined methods over those just described but these are outside the scope of this article.

Perhaps a word of warning should be added before concluding. When using RWM Moscow, there are times when the signal is coming via the long path and unless this is appreciated, serious errors in readings will result. There are even times when the signal arrives via both the short and long paths. As such, it can be an interesting study in propagation!

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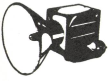

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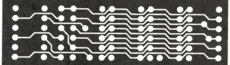

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Basics of Radio Transmission & Reception

Tuning & Sine Waves – 2

This month we consider the need for radio receivers to be able to select signals from just one of the hundreds of radio transmitters on the air, rejecting all others. The simplest method is to use a 'tuned circuit', but to understand this we must look into the special properties of sinewave currents, voltages, and their effects on linear circuits.

by BRYAN MAHER

When James Clerk Maxwell predicted radio waves in 1864, and when Heinrich Rudolph Hertz actually demonstrated radio transmission in 1887, these happenings were seen by the intelligentsia as fascinating efforts, probing the secrets of nature – but of no application to you and I.

But their work intrigued one man, Guglielmo Marconi of Bologna in Italy. In 1894 Marconi repeated Hertz's experiments using much lower frequencies between 50 and 500 kilohertz, sending and receiving radio transmissions over a distance of nearly two kilometres.

Marconi used an electric arc to generate radio frequency electric currents, which he passed through an inductance coil. This coil and some associated capacitance set a basic frequency, and a connection to a long wire antenna completed his transmitter. The whole thing was powered by batteries and a DC generator, the flow of current being turned on and off by a Morse key acting as a switch.

To send messages he simply switched his transmitter on and off, using the code of short and long timing like the dots and dashes employed by Samuel Morse since 1837.

His receiver was basic, not much more than a long wire receiving antenna and an apparatus to react to the presence of radio frequency currents. Later earphones were added and the system was called 'Wireless Telegraph'.

First radio patent

His own country's government uninterested, Marconi moved to England, floated a public company, and took out the famous English patent No.7777, the world's first radio patent. Filling the obvious need for communication by ships isolated at sea, Marconi's equipment saved lives in the first sea rescue initiated by radio, when the Goodwin Sands Lightship was in trouble in 1899.

By December 12, 1901 Marconi ha managed to transmit and receive th first trans-Atlantic radio message, usin a Baden-Powell design high-flying kit to elevate his receiving antenna.

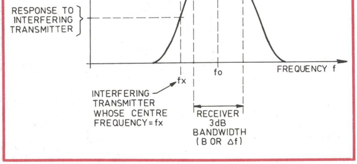
As the number of these crude radi transmitters grew, it became impossibl to receive just one transmission, rathe a number of transmitters were receive simultaneously, leading to endless confusion. Not only were the receivers o the day incapable of selecting just on transmission, but each transmission occupied a wide band of frequencies, s that they often overlapped each other.

Their systems needed much mor *selectivity*, or the ability to select wanted signal from all of the others.

Transmitter bandwidth

It is a fact of nature that it will neve be possible for a radio transmitter t send any information while putting ou only a single-frequency transmission The very act of sending informatio causes the transmission to 'spread' fro a single frequency into a *band* of fre quencies. Although modern transmitter can keep this spread extremely small i some cases, by using special techniques

We call the width of this band of fre



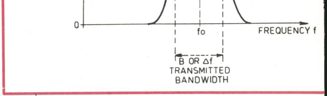


Fig.1 (above): The curve of frequencies occupied by a radio transmitter, because of its modulation.

Fig.2 (left): The selectivity curve of a receiver, with an interfering transmitter at frequency fx.

quencies transmitted from a simple transmitter the *bandwidth*, as illustrated in Fig.1.

If only Morse code is to be transmitted, then we desire the bandwidth to be as narrow as possible, so that more transmitters on different frequencies could be in use at once, without cross-interference. In fact we'd really like the bandwidth to shrink and approach that unattainable perfection, a single frequency (zero bandwidth).

To express the bandwidth of a transmitter we measure the width of the graph of transmitted frequencies, Fig.1. But we must clarify just where on the curve we measured the width. Standard practice is to measure the width of the curve at a point halfway down from the top, called half power level.

The 'Bel', (named to commemorate Alexander Graham Bell) is defined as a logarithmic unit of power ratio. An upward step of one Bel means a tenfold increase in power level. We usually use the smaller unit, the decibel, (abbreviated dB) which is one tenth of a Bel.

If you want to express the half power level in logarithmic decibel units, then as the logarithm of half power is -0.3010 Bel, then to use the decibel unit we must multiply by 10 (because 10 decibels make one Bel).

So half power is expressed as
10 log(1/2) decibels = 10.(-0.3010) decibels
= -3.010
or approximately = −3 decibels
which is written as: −3dB

Receiver bandwidth

It sounds logical to say that the receiver ideally should be capable of receiving just that band of frequencies put out by the transmitter, rejecting all others. The response of a receiver to a certain band of frequencies is known as the receiver's bandwidth. Graphically the bandwidth of a simple receiver is represented by a response curve as in Fig.2.

If such a receiver is tuned to the wanted centre frequency, shown as f_o, it will respond to that frequency at full volume output. The response to the other frequencies on either side of the centre frequency can be read from the curve, Fig.2. That band of frequencies to which the response is above the half power level is known as the *bandwidth* of the receiver and is labelled 'B' (or sometimes 'delta f'). Note that the half-power level corresponds to 70.71% of maximum voltage.

Receiver selectivity

The response of the receiver to unwanted frequencies (transmissions from other radio stations) should be zero, ideally. But if unwanted stations operate on frequencies not very different from the frequency of the wanted station, our receiver will respond in a small way to those unwanted stations.

The ability of a receiver to select the wanted station and reject unwanted transmissions close on the frequency scale is called the receiver's *selectivity*. Receivers which have narrow bandwidth (B in Fig.2) are said to have high selectivity.

In simple receivers selectivity is just the inverse of bandwidth. But complex receivers can be built in which the response curve can be forced into a different shape, as in Fig.3, so that while B may be just as wide, the 'skirt' of the response curve falls away more sharply.

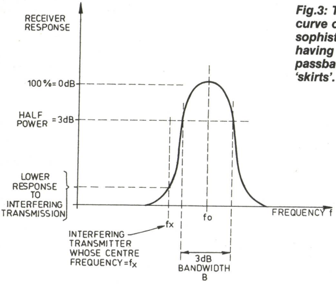

RECEIVER RESPONSE
100%= 0dB
HALF POWER =3dB
LOWER RESPONSE TO INTERFERING TRANSMISSION
fx
fo
FREQUENCY f
INTERFERING TRANSMITTER WHOSE CENTRE FREQUENCY=fx
3dB BANDWIDTH B

Fig.3: The selectivity curve of a more sophisticated receiver, having the same passband but narrower 'skirts'.

A complex receiver having a response curve as in Fig.3 still receives the desired transmission as well as the simple receiver shown in Fig.2, but its response 4 to other unwanted stations transmitting on close frequencies such as fx is much lower. Hence the reception of the wanted station is improved.

Receiver sensitivity

Although a transmitter may send out a very powerful signal, the strength of that signal decreases as the square of the distance we move away. This is simply because the area of the circle or arc of a circle (on a map) illuminated by that transmitter's signal, is proportional to the radius squared. The signal is diluted over that whole area.

To receive a signal from a transmitter at a long distance, say from England to Australia, or from a spacecraft, our receiver must be sensitive enough to respond to a tiny signal of a few microvolts.

We define receiver *sensitivity* as the minimum number of microvolts or millivolts of radio frequency signal to which our receiver will respond and produce useful output. A high sensitivity receiver must obviously have high voltage gain and furthermore must not introduce much noise into the signal.

Signals from other unwanted stations, (some closer, and hence stronger) and/or noise and interference signals all must be rejected by our receiver's selectivity. Such a receiver might be fairly expensive and complex, to combine the qualities of high sensitivity and high selectivity.

A much easier task is designing a receiver to receive only the local broadcast stations in our local city. As we live only a few kilometres from the transmitter the signal is strong and any other stations on adjacent frequencies are, by law, situated hundreds of kilometres from us in other cities.

So unwanted transmissions are either weak (from stations far away) or, if in our city, spaced well apart on the frequency scale. The sensitivity and selectivity demanded of a receiver for local city reception are thus only moderate and easily met by a low priced receiver.

Television systems are a different proposition, for by the nature of the video picture signal and the methods used, the transmitter *must* put out a signal which occupies a very wide transmitted bandwidth.

Therefore television receivers have very special requirements regarding their bandwidth. The TV receiver's response curve should exactly match that specified by the Government Authority so that every aspect of picture and sound will be correctly presented to viewers.

The sensitivity requirements of receivers in various situations are given by the expected amplitude of signals from the desired transmitter, measured at the receiver's location. Some representative examples are given in Table 1.

Effects of RF currents

To understand selectivity, the ability of a receiver to 'tune in' to one transmitting station and reject all others, we must first learn something about alternating radio frequency (RF) currents and their effects on the fundamental electronic components of *resistance*, *inductance* and *capacitance*.

All radio frequency currents are alternating currents (AC), meaning that current does not flow continuously in one direction like direct current (DC). Rather, alternating currents flow back and forth in a circuit, the values of voltage and current changing continuously through a whole range of values as in the full line in Fig.4.

The current value varies from zero up to a highest value called i_{peak} or I, down again, through zero, down to a peak negative value (-I), then up again to zero. It continually goes through this cycle of positive values, then negative values, then positive and so on.

The full line in Fig.4 is a graph of these current variations, the vertical axis representing current value at any instant of time, the horizontal axis representing time. The shape of this graph is called the *sinewave* current waveform.

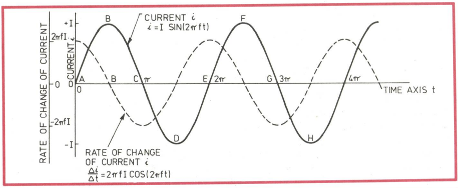


Fig.4 (above): Graph of a sinewave current I, shown as a full line, and its rate of change (dashed line).

APPROX SIGNAL FREQUENCY	TRANSMITTER	TRANSMITTER LOCATION	RECEIVER ANTENNA LOCATION	APPROX DISTANCE TRANSMITTER TO RECEIVER	MEASURED RECEIVED SIGNAL STRENGTH MICROVOLTS
UHF	TV CHANNEL 9	TAMBORINE MOUNTAIN	GOLD COAST CLEAR AREA	24 km	1000 to 20 000
UHF	TV CHANNEL 9	TAMBORINE MOUNTAIN	GOLD COAST BEHIND HIGH RISE BUILDING	24 km	20
VHF	TV CHANNEL 2	GORE HILL SYDNEY	TOP OF CITY BUILDING	5.3 km	300 000
VHF	TV CHANNEL 2	GORE HILL SYDNEY	MID - WESTERN NSW	500 km	2
BROADCAST RADIO	SYDNEY LOCAL STATION	RHODES	PARRAMATTA ROAD	3 km	400 000
HF	BBC	ENGLAND	AUSTRALIA	17 000 km	2
10 GHz	NASA SPACECRAFT	NEAR THE PLANET PLUTO	TIDBINBILA A.C.T. AUSTRALIA	4800 000 000 km	0.00001

Table 1: Representative samples of measured signal strength from various kinds of transmitter, at various locations.

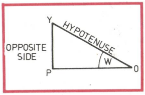


Fig.5: If angle W is less than 90°, sin W is equal to UP/YO (opposite side over hypotenuse).

Sine waves

Although it is possible to generate almost any waveform, the sinewave shown is the one most often met, both in power AC work with power stations, motors or home appliances, and in radio frequency (RF) work with radio transmitters and receivers.

You wonder why any preference is given to the sinewave shape over any other waveform. There are a number of reasons, which will unfold as we go on. They all arise from one unique property possessed by the sinewave shape alone.

In Fig.4 we have labelled the full line graph of current 'i'. If you observe its range of variations, you will notice that where it is passing through zero at points A or E, it is changing value rapidly. I.e., the *rate of change* is a large value. We call upward changes as A and E positive changes, while downward changes as C and G are considered negative changes.

Another thing we notice is that near the maximum values B, D and F, the value changes only slowly. Here the rate of change is a small value. With zero change occurring right at the top at B or F, or the bottom at D or H, we naturally say the rate of change is zero when the current value is greatest positive (I), or greatest negative value, (-I).

The numerical values of the rate-of-change (in amps per second or perhaps milliamps per micro-second or whatever) can also be graphed, which we have done in the dashed curve in Fig.4

Now we observe a peculiar property of the original sinewave current, the full line curve in Fig.5:

The shape of the graph of values of rate-of-change of current (the dashed line in Fig.4) is exactly the same as the graph of current itself (the full line in Fig.4). The only difference is that it is shifted along.

This property, that the rate-of-change follows exactly the same set of variations as the original sinewave is unique to the sinewave form. No other repetitive waveform has such a property!

True, the rate-of-change dotted curve is shifted along, but still the shape is the same. Correctly speaking the mathematical name for that dotted curve is the 'Cosine' or 'Cos' curve – the Cosine function being a 'shifted-along sine curve'.

Back to school

Having paused for a breath, we perhaps wonder why the name 'sine' waveform? At school the 'sine' function was taught as:

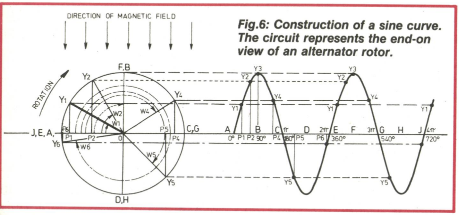


Fig.6: Construction of a sine curve. The circuit represents the end-on view of an alternator rotor.

In a right angle triangle, the sine of an ngle is the ratio of the length of the ide opposite that angle to the length of he hypotenuse.

Recall that the hypotenuse is the side pposite the right angle, as is Y_0 in ig.5; also the word 'sine' is often ab-reviated to 'sin'. Because in that figure Y is the side opposite angle W, we ay:

The sine of angle W in Fig.5 is equal o:

sin(W) = PY/YO

eal life sinewaves

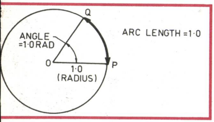
But what on earth does that have to o with waveforms of real electric cur- ents? Well, the easiest way is to think f an electric generator in a power sta- on, where a large magnetised rotor is evolving continuously inside a set of uge stationary coils called the stator. he rotating magnet generates sinewave C electric currents in the stationary oils.

It can be shown that this generating ction is well represented by a circle iagram, like the left side of Fig.6. A ircle, centre O, and radius 1.0 unit, is raced out by a point Y revolving round a path from A to B to C to D, hen to E (which is just A the second me around) and so on.

In the circle, the sine of angle W_1 is imply:

$\sin(W_1) = P_1Y_1/Y_1O$

As the hypotenuse Y_1O is the radius, hosen as unit length, then in this case:



g.7: In a circle of radius 1, an arc Q of the same length subtends an ngle of one radian.

$$\sin(W_1) = \text{height } P_1Y_1/1.0$$
$$= \text{height } P_1Y_1$$

Now let point Y move around the circle, say to Y_2, where it subtends angle W_2 at the centre. Here:

$\sin(W_2) = \text{height } P_2Y_2$

And we see the larger angle W_2 gives a larger sine value, but not in proportion. When the moving point Y reaches B it achieves a sine value equal to the radius which is 1.0, for an angle

$W_3 = 90°$.

Therefore:

$\sin(90°) = 1.0$

Continuing on around the circle, say to Y_4, the sine value P_4Y_4 is decreasing, until the angle W becomes greater than 180° at points such as Y_5 where P_5Y_5 points downwards. Hence we say that for large angle W_5 (greater than 180°), the sine value is negative.

Point Y can revolve around the circle as many times as we like, revolving at some speed of rotation. In the power station it revolves at 3000rpm, or 50 revolutions per second. Now let us plot all those sine values, all the lengths PY as in the right hand side of Fig.6.

The continuous curves obtained by plotting all those heights PY gives a repeating sine curve, as you can see. Here the base line represents the time taken for Y to revolve, and obviously it can also represent the angle through which Y has revolved. So we mark the base line as an axis of time and also of angle in degrees.

An alternative measure of angle also commonly used is the *radian*, where

1 radian = 360°/2π

and π = 3.141592....

We define a radian in a unit circle (Fig.7), where the centre is O, radius OP = 1.0, and Q is a point such that the arc PQ is also of unit length (curved length). Then the angle QOP is defined as equal to one radian (abbreviated *rad*).

Marking the baseline of Fig.6 in radians, we mark 2π radians at 360°, π radians at 180°, etc. Often the unit 'rad' is omitted and just π or 2π etc written as angular measure.

Frequency

The number of times per second the point Y in Fig.6 rotates through complete circles is called the *frequency*. As noted in the first of these articles, frequency is measured in units called Hertz, abbreviated 'Hz'.

In radio frequency work the AC sine wave is generated by an electronic circuit called an 'oscillator'. As the oscillator has no rotating parts, it is not limited to the value 50Hz as generated by the power station's machines. Rather, oscillators for radio transmitters generate sine waves having frequencies of thousands, millions or billions of Hertz.

We give the names for these high frequencies as:

1 kilohertz (1kHz) = 1000Hz
1 megahertz (1MHz) = 1 000 000Hz
1 gigahertz (1GHz) = 1 000 000 000Hz

In any one system the voltage associated with all this alternating current has the same frequency as the current.

Special properties

We should always keep in mind Fig.4, that picture showing the 'rate of change' of a sinewave being a cosine curve, the same shape as the original sine curve. This property is unique to sinewaves.

There are two vital and far reaching consequences of the above, and they have to do with 'linear circuits' which we define as:

A linear circuit is any circuit consisting only of constant values of resistance, inductance and capacitance; in any quantity and any combination.

Now those two consequences which are unique to sinewaves (or cosine waves) are:

(1) In any linear circuit, if the current is of sinewave shape, then so is the voltage; and vice versa.

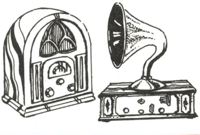
(2) In any linear circuit, if the input voltage is a sinewave, then so is the output voltage.

To be sure, in linear circuits sine wave voltages and currents may be shifted along the baseline, either advanced or retarded, with respect to each other, and perhaps made larger or smaller, but they always will have that same shape.

Let's pause here, take a big deep breath, and rest until next time when we will delve into the strange effects radio frequency currents can have on inductance and resistance. Bye!

Vintage Radio

by PETER LANKSHEAR



The remarkable Philips V7A "Theatrette"

With introductions over, I thought we'd look this month at an unusual model from the late 1930's – one that is not only quite intriguing, but still quite well represented by working examples.

With the advent of the mains powered receiver in the late 1920's, there was a rapid standardisation of construction methods. The traditional inverted metal tray or chassis, being suited to mass production and keeping high voltages away from unwary fingers, was adopted universally within a very short period. Increasing receiver gain meant that the shielding afforded by the metalwork was valuable.

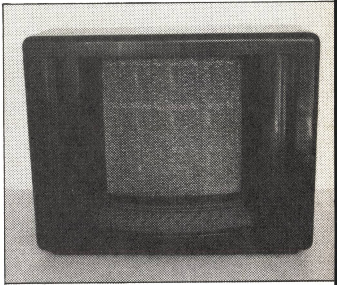
Different chassis styles soon became identified with certain manufacturers. RCA and AWA tended towards deep chassis, whilst for a while, Atwater Kent featured chassis only an inch or so in depth. At one stage, New Zealand's Radio Corporation, who for a few years sold their Columbus receivers in Australia, used a chassis that was for all the world like an inverted baking dish, complete with rounded corners.

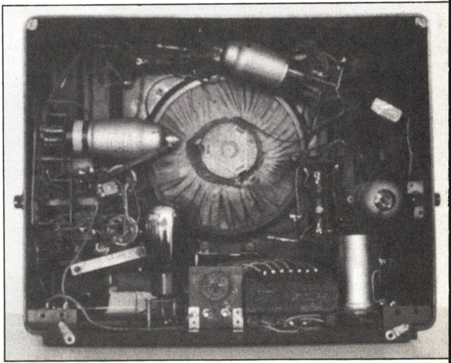
Radios built in America and Australasia had plain chassis. British and European manufacturers tended to have more elaborate metal work and were not so concerned about appearance and exposed high voltage points. For safety and finish, receivers from these countries were fitted with fibre or heavy cardboard backs. In the US, Atwater Kent for a while produced receivers that were so well finished in nickel plate and rich brown enamel that they could be used without a cabinet. Later the legendary Scott and McMurdo silver chromium plated masterpieces were often proudly displayed without cabinets.

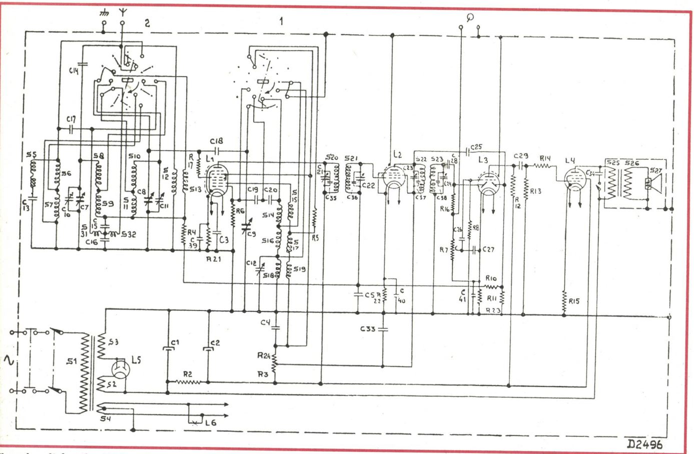
Today's electronics are built on printed circuit boards which, if well designed, can be attractive and tidy. The underside of the traditional valve chassis was, in many cases, what can only be described as "functional". Whilst perfectly adequate, the wiring was not intended for display, and the term "rats

Right: On the outside, the Philips V7A looked very nice – rather like a miniature theatre proscenium, hence the name "Theatrette". It worked well, too.

Below: But inside, it was a MESS – with no chassis, and parts attached willy-nilly all around the inside of the Bakelite cabinet. A serviceman's nightmare!







he circuit for the V7A, a 5-valve superhet. Electrically it was quite a good performer.

est" was an apt description. Unless the hassis was withdrawn from the cabinet, he wiring was out of sight anyway. hat was, until the advent of the Philips 7A!

he Theatrette

In 1937 Philips introduced a radio at was remarkably good value. Selling Britain for 6 guineas and about dou- e that in this part of the world, it fea- red the European Long Wave Band, roadcast Band and the main Short- ave Band. There was an 8" speaker, a rge illuminated dial and a well made akelite cabinet.

The impression given by the recessed eaker opening is that of a theatre pro- enium, whilst the curved dial can be kened to the footlight area of a stage. ot surprisingly the V7A was called the 'heatrette". With its distinctive appear- ice, excellent performance and above l, remarkably good price, the V7A ld well. It proved to be very durable d many have survived to this day.

There had to be a catch somewhere. ow could a radio with such an excel- nt specification sell at about half the ice of the competition?

All is revealed

The shallow cabinet of the V7A has the conventional type of well fitting back concealing the internals from prying eyes and fingers. The average owner was not concerned about removing the back so did not know, or for that matter, care what was inside. All he knew was that he had purchased a sensitive, nice sounding radio that was reliable and obviously good value.

If, however, the back is removed, what is revealed is not for delicate sensibilities. The V7A has no chassis and the rats nest of wiring is quite exposed. In fact, it looks a thorough mess. Even the IF transformers are unsheilded. The general impression is of a workbench lashup that has been dumped unceremoniously into the cabinet. There are valves sitting at all angles and loose wires are hung on the ends of components without the benefit of tie points.

Mess production!

To produce rock bottom prices in a competitive market, conventional manufacturing techniques demanded economies in loudspeaker and cabinet size and quality. Multiband operation and an elaborate dial would also have been out. But these were the very things that made for ready sales. The V7A had all of these features, so savings had to be made in other directions. The two remaining items were metalwork and labour. Chassis metalwork was eliminated by strategic placement of components around the cabinet, with the resultant apparent chaos. Labour costs were cut to an absolute minimum by extreme attention to time and motion studies.

The result was an unusually successful receiver that outlasted many of its more expensive and conventional contemporaries, and which has now become a collectors' item.

Variations of the original "Theatrette" may be found. A later model was the "Matador" using side contact "P" base valves, whilst Mullard, a Philips subsidiary, sold a more ornate style they called the "Westminster". For DC mains there was the transformerless V7U, but I am unaware of any being sold in this part of the world.

The circuit

Like most receivers from Philips, the V7A was well designed electrically. There were few shortcuts and no scrimping of components. The circuit is basically the conventional 5-valve superhet that formed the backbone of the radio industry for a quarter of a century. An octode mixer stage is followed by a 128kHz IF stage. Detector and AGC diodes are separate and included with the triode audio amplifier. The high performance output pentode has some negative feedback from the unbypassed cathode bias resistor. Finally, the resistance-capacitor filtered power supply is conventional except for the half-wave HT winding. This was probably done to standardise the design to include the transformerless V7U. Unlike many manufacturers Philips, when producing budget-priced sets, did not compromise performance by paring component counts. The V7A is therefore a textbook exercise in conservative design with high gain and stable performance.

The very low frequency of 128kHz for the IF is governed by the provision for the long wave band, covering from 413 to 152kHz. The IF amplifier has the advantage of high gain and good selectivity, but poor image response on the shortwave band.

Although carrying a Philips brand name, most V7As were fitted out with Mullard valves which carried different numbers from their Philips equivalents. With the exception of the 4 pin rectifier, these were from the 7 pin 4-volt filament European series. All other 1937 Philips receivers used the new side contact "P" base series.

Servicing

Anyone unfamiliar with Philips sets of this era is likely to be puzzled by the trimmer capacitors. These consist of an insulated inner conductor wrapped round with a layer of fine tinned wire. Trimming involves peeling off the fine wire until tuning is correct. That is OK, but if you go too far it is difficult to get the wire back on! Philips sets were pretty stable so the best advice is to leave well alone if the dial readings are reasonably correct.

One reason for the longevity of Philips receivers is the quality of their components. It is not at all uncommon to find sets like the Theatrette still going well. Items to look at are any capacitors connected to grids. If any leakage whatsoever is detected they should be replaced with modern plastic film types. The filter capacitors may be showing their age, but don't use anything larger than about 40uF for the input capacitor, or the rectifier will suffer.

The most likely problem to be encountered and common to all pre Wa Philips receivers is perished insulatio on the hookup wire. Cracked and brittl yellow rubber falls off in large lumps a the slightest disturbance. Never switc on one of these receivers without firs checking this condition.

The remedy is obvious but time consuming. Renew leads one at a time with the same length and positioning Philips' little wire spirals make reconnection easy. Try and locate replacement wire that looks like the original Nothing looks worse in a vintage radi than garishly coloured shiny plastic insulation.

Finally, I have heard that Australia shoppers may have difficulty in locatin high voltage capacitors suitable fo valve work. A good range of 450 vo electrolytic and 630 volt mylar capac tors is available from David Reid Electronics stores in New Zealand, and the assure me that they have good stock The firm's postal address is C.P.O. Bo 2630, Auckland, N.Z.

Interested in joining the staff of EA?

Australia's leading electronics magazine requires a project designer/writer for its editorial staff. This position involves the design and development of hobby electronics projects, and then writing about them for the magazine.

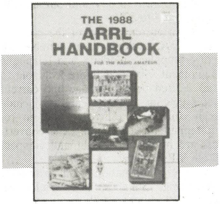
You'll need a sound knowledge of electronics theory and practice, and lots of **enthusiasm.** You'll also need to be able to express yourself clearly, in writing. But apart from that, we have no preconceived ideas about your background. You might be a student, a technician, a fully qualified engineer or just a keen enthusiast.

If you believe you're the person we're looking for, ring Jim Rowe on (02) 693 6620, or send your resume to him at Electronics Australia, Federal Publishing Company, 180 Bourke Road, Alexandria 2015.

Books & Literature

Ham radio "bible"

HE 1988 ARRL HANDBOOK FOR
HE RADIO AMATEUR, edited by
Mark J. Wilson, AA2Z. Published by
he American Radio Relay League, 1987.
Hard covers, 285 x 216mm, 58mm thick.
SBN 0 87259 065 8. Recommended re-
ail price $49.95.



Well, here it is – the 65th annual edi-
on of the ARRL's world famous hand-
book of amateur radio, which has been
pdated and expanded almost continu-
usly ever since it was first published
ay back in the days of spark transmit-
ers and crystal sets. And this is the first
dition to be published exclusively in
ard cover form, making it rather more
urable than earlier editions.

As with all of its predecessors, it's
asically not just a handbook on ama-
eur radio as such, but a first-rate intro-
uction to the whole subject of electricity, electronics and radio communications. Accurate, practical, readable and highly informative – a truly outstanding achievement.

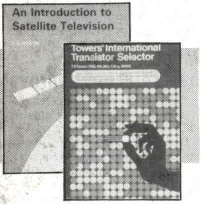
I can still remember reading the first edition of the ARRL handbook to come my way, given to me by my uncle way back in about the mid 1950s. I found its down to earth approach very accessible and encouraging, and it may well have influenced me not only in moving into electronics as a career, but also into becoming a radio amateur later on. I'm sure it must have influenced many others in the same way.

There's no doubt that this latest edition carries on the tradition. As well as being fully updated, with treatment of all the latest technology, its treatment of the basic concepts represents the results of decades of refinement and polishing. And as usual, the practical circuit designs for build-it-yourself gear are simple and well thought out.

Even more than ever before, then, a book which belongs on the reference shelf of almost everyone in electronics – from beginner to engineer, and regardless of whether you're interested in amateur radio or not. If you are, you'll find it even more valuable. How many books would qualify for that description?

It's not cheap, to be sure, but if any book is worth 50 bucks, this one certainly is.

The review copy came from McGills Newsagency, in Melbourne. (J.R.)



Transistor index

TOWERS' INTERNATIONAL TRAN-
SISTOR SELECTOR, by T.D. Towers.
Third updating, published by Foul-
ham/BPB Publications 1985. Soft
covers, 245 x 178mm, 379 pages.
Recommended retail price $35.00.

Discrete transistors are still used in an
enormous range of electronic equip-
ment, and over the years there have
been a staggering number of different
ypes made. Small wonder that the
chances of coming across an unknown
ype are very high indeed – whether
you're a service technician, a student
rying to salvage parts from a piece of discarded gear, or a hobbyist who has simply been asked to get someone's prized old "tranny" going again.

Over the years T.D. Towers' International Transistor Selector has become very widely used as a cross reference and substitution guide. This recent edition is updated, and lists no less than 27,000 different devices from manufacturers all over the world, giving all basic specs and connection details. It may not be the most comprehensive guide available, but is certainly very good – and much cheaper than the really fancy ones.

Unless you're absolutely rolling in money, it's therefore an excellent choice.

The review copy came from Jaycar Electronics, which stocks it under the catalog number BM 4554. (J.R.)

Satellite TV

AN INTRODUCTION TO SATELLITE TELEVISION, by F.A. Wilson. Published by Bernard Babani, 1988. Soft covers, 264 x 195mm, 104 pages. ISBN 0 85934 169 0. Retail price $12.95.

With interest gradually growing in the reception of satellite TV transmissions, this book should also find a warm reception – if only because as yet, reading about the subject is about as much as most Australians will be able to afford.

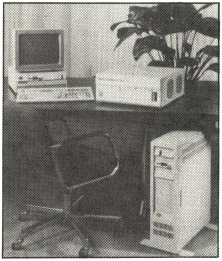
Even overseas, where satellite transmissions are less heavily encrypted than here, the cost of equipping yourself to receive and decode them is still fairly steep. Our Government's decision to go with the BMAC system has simply made it that much dearer again... Still, you can always read about it in books like this, and be ready if the opportunity ever presents itself.

Author F.A. Wilson is a well-known UK technical author, and in this unassuming little book he has produced a very readable introduction to the subject. It progresses from very basic concepts right through to selecting and setting up practical TVRO systems, with plenty of general explanation along the way. There are also some 11 data appendices at the rear, with a lot of useful reference information – including a glossary of satellite TV jargon.

All in all, a well written and useful book on the subject, and good value at the price quoted.

The review copy came from Federal Marketing, who are offering it to readers via mail order – see their advertisement elsewhere in this issue. (J.R.)

New Products



First Image Processor for System/2

Imaging Technology Inc (ITI) has announced what it claims is the industry's first real-time, modular image processor for IBM's Personal System/2. Called the Series 151, the subsystem enables PS/2 users to perform high-performance image processing on the new Micro Channel bus.

With the modular Series 151, users can build PS/2-based image processing systems that span a wide range of performance. Because all software developed for the Series 151 on the PC AT is fully compatible, a broad range of software is available immediately for PS/2 users.

The Series 151 is housed in a self-contained chassis with either seven or twelve slots for image processing boards. A bus interface, requiring only one slot in both the Series 151 chassis and the Personal System/2, allows the PS/2 Models 50, 60, and 80 to control all operations of the image processor.

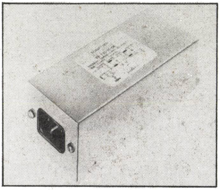
The Series 151 captures from CCIR, RS-170 and nonstandard video sensors such as line – and area-scan cameras. Once digitised, images are processed in real-time using one or more pipeline image processing boards. Capabilities include real-time averaging, subtracting, convolutions with programmable 8 × 8 kernels, histograms, feature extraction, binary correlation, morphology, and median filtering. For further information contact The Dindima Group, P.O. Box 106, Vermont, 3133 or phone (03) 873 4455.

DC-DC converter

Rohm Co of Japan has released the BP5000 series of PWM-type hybrid DC to DC converters, with input voltages ranging from 8 to 30V and output voltages from 5 to 12V.

Output current rating of the converters is 1A, making them suitable for power supplies, modems and telephone equipment. Six models are available to suit desired output voltage and current requirements. Other features include high conversion efficiency and no requirement for a heatsink. The converters are housed in a light and compact 9-pin SIP package.

Further information from Fairmont Marketing, Suite 3, 208 Whitehorse Road, Blackburn 3130 or phone (03) 877 5444.



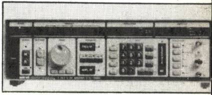
Heavy duty line filter

Scaffner has developed the line filter series FP 710, which is suitable to discharge NEMP (nuclear electromagnetic pulses) and LEMP (lightning electromagnetic pulses) pulses and filter out interference signals.

The single phase filters consist of a discharge overvoltage section followed by a wide band mains filter.

In many cases the FP 710 can be used as a simple and cost effective solution. For projects with exactly defined requirements usually customer specific filters are necessary. For these projects Schaffner has a group of engineers available who are able to offer tailor-made solutions developed for your application.

Enquiries to Westinghouse Systems, P.O. Box 267, Williamstown, 3016, or (03) 397 1033.



Signal generator is spectrally pure

Vicom Australia has released the ne Adret 742A Signal Generator, whic boasts high spectral purity over frequency range of 100kHz to 2.4GHz.

Adret (now a subsidiary o Schlumberger) has produced a instrument which addresses the needs o spectral purity close to the carrier, hig quality modulation and very lo residual FM for both CW and F modes.

The 742A also has some othe interesting features including DC an AC coupled modulation input wit switchable ALC, programmable interna AF generation from 20Hz to 12.8kH and a very low RF leakage of bette than 0.5uV.

Further details can be obtained fro Vicom Sales Offices throughou Australia, or by phoning (03) 690 9399

Micro-reed relay has Telecom approval

IRH Components has received Telecom Australia engineering approval fo the new Fujitsu micro-reed relay.

Designated FRL 644E – 04 series this relay conforms to Telecom Spec 1302 and has Telecom Engineering Approval No. RA 87/101.

With improved clearances betwee contacts and coil terminals the FRL644E – 04 series offers isolation o 3.5kv RMS for one minute. A heavy duty form A reed switch insert is rated at 50VA to ensure reliable operation in pulse type application such as automatic telephone diallers.

Power consumption is only 140mW at 20°C (12 volt DC coil). Using epoxy encapsulation the relay is suitable for automatic flow soldering and immersion cleaning and has a height of only 9mm. Pinout suits a standard 2.54mm (0.1") PCB grid. Further information is available from IRH Components at 32 Parramatta Road, Lidcombe 2141 or (02) 648 5455.

echargeable antern battery

he most recent addition to the Arlec nge of rechargeable products is a 6 lt lantern battery which can be re- arged hundreds of times. The Arlec echargeable 6 Volt Lantern Battery mply replaces the Eveready No.509 ed), No.1209 (black), No.529 (Ener- ser) and other common disposable 6 lt batteries.

The Arlec 6 Volt Lantern Battery Kit supplied with two chargers, one that ugs into a regular household power- oint (240 volt) and the other plugs into e cigarette lighter socket of a car or uck (12 volt). Additional Batteries are so available without the chargers and oth the Kit and the Battery itself in- udes a spare 7.2V, 0.55A globe.

When fully charged the battery has a eavy duty 5000 milliamp hour rating 000mAh). Based on the testing stand- rd AS2176 – 1986 Primary Batteries, hich involves a specified "ON" time llowed by a specified "OFF" time, the attery will last up to 11 hours and 24 inutes each cycle before charging is equired again. The battery cannot be vercharged and is leak-proof and main- enance free.

Further information from Arlec, 30-32 exton Road, Box Hill 3128, or (03) 95 0222.

lectronic tire pressure auge

The world's first microprocessor con- olled tire pressure gauge from Sensym as no moving parts, and instead relies n time proven semiconductor piezo esistive sensor technology as used for ressure sensors on jet aircraft. An in- rnal microprocessor captures and dis- lays tire pressure in less than a second n a liquid crystal display.

The Sensym gauge has a range of easurement from 1 to 127psi with an ccuracy of ±1psi, and can be used to ead tire pressures for bicycles, off road ehicles, through to trucks.

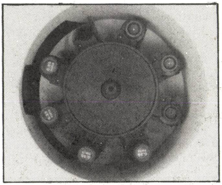
For further details contact NSD Aus- alia, 205B Middleborough Road, Box ill 3128 or phone (03) 890 0970.

Array processor for Micro VAX II

Occupying a single slot in the backplane of a MicroVAX II computer, the single-board MicroMSP-4, from Computer Design & Applications, Inc. (CDA) does real-time and numerically intensive signal and image processing at speeds up to 100 times faster than an unaided MicroVAX II.

CDA's MicroMSP-4 performs up to 20 million 32-bit floating-point operations per second, making it suitable for a wide range of medical, imaging, instrumentation and test, geophysical, graphic arts, sonar, radar, and communications applications. It does a 1024-point complex FFT in 4 milliseconds, a 512 × 512 complex 2-D FFT in 2.5 seconds, and FIR filter tasks at a speed of 100 nanoseconds per tap.

Further information from Kenelec, 48 Henderson Road, Clayton 3168 or phone (03) 560 1011.



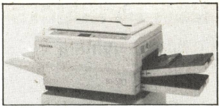
A0 and A1 plotters

Roland Australia has released its new GRX series A0 and A1 high speed, high resolution grip wheel plotters. The free-standing units have been developed around a new generation micro-stepping motor which Roland says enables precise resolution at high speeds and much lower costs.

The GRX-400 A0 plotter operates at speeds of 600mm/sec with 3Gs of acceleration, while giving resolution accuracy of 1.56 microns. This accuracy is finer than the tip of any pen, and enables drafting of plans which can be used with greatest accuracy in the field.

Roland is also shipping the GRX-300 A1 plotter, which has the same speed and accuracy specifications as the GRX-400 and is also HPGL II compatible, with both parallel and serial input ports.

For further information contact Roland Digital Group, 50 Garden Street, South Yarra, 3141 or phone (03) 241 1254



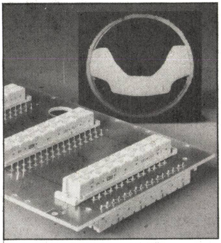
Flexible new copier

Toshiba's new BD-5110 desktop executive and small office copier packs a lot of talent into a small package.

At 18 copies a minute, the new copier is no slouch and offers all the "big machine" capabilities. It has enlargement and reduction modes in one-touch controls, and it can zoom from 65% to 154% in 1% increments which means 90 intermediate sizes.

Other features provided by the machine include A5 to A3 sizes, programmed 99-copy run, dual page copying, three-way paper supply and interrupt key for those quick copies required during the long print run.

For further information contact Philip Earl Toshiba Copier & Facsimile Division or (02) 887 6054.



"Eurocard" connectors

Erni Australia has announced new DIN 41-612 "Eurocard" connectors to complement the company's 600-plus range.

The new "H11" and "H15" female connectors are designed for soldering or "press-in" solderless connection to PC boards, and can now be fitted to the back plate in back-panel wiring systems. Earlier versions were suitable only for mounting on the PCB itself.

Although these connectors have a lower housing height they can be mated with the male "H11" and "H15".

Further information from Erni Australia 12 Monomeeth Drive, Mitcham, Victoria 3132 or (03) 874 8566.

New Products

Computer lighting controller

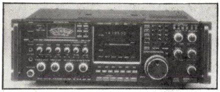
An Australian designed and manufactured lighting control system based on the Commodore 64 personal computer has been released by Entertainment Systems and Design.

The Comstar-64 provides 64 output channels and programming for 64 scenes. It also provides 8 x 8 step chases, multi-step chase loops, four-band colour organ facilities (expandable to eight band), and independent fade times per channel per scene (from 0 to 240 seconds).

Programming is via easy-to-use custom software, and programs may be saved on floppy disk for later use. Controller outputs are 0 to 10V DC, of either polarity.

ES&D claims that the system bridges the gap between previous keyboard controlled machines and standard manual desks, and provides the contemporary lighting designer with the means to enter a new era of lighting control.

Further information from Entertainment Systems & Design, 88 Inkerman St, St Kilda 3182 or phone (03) 537 1871.



New Icom HF transceiver

Hot on the heels of its popular new IC-761 HF amateur radio transceiver released late last year, Icom has now released the IC-781. This is a vastly more sophisticated HF 'super-base' with features that are claimed capable of surprising even the most seasoned reviewers.

The central feature of the IC-781, both visually and technically, and one which sets it apart from the competition, is a large multifunctional cathode ray tube (CRT) providing visual, menu-driven tracking of memory data storage, multiple filter configurations and VFO settings.

As if that's not enough, the CRT also doubles as a powerful spectra-scope, displaying up to 200kHz of the spectrum in graphic detail for instant location of interfering signals, close analysis of received transmissions, wide-band DX signal spotting and visual tuning of digital transmissions. Spectra-scope bandwidth is selectable at 50, 100 or 200kHz, and a highly accurate built-in log amplifier allows accurate measurement of received signals from 0-50dBu.

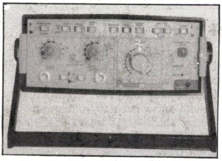
The IC-781 also provides a Dual Watch facility, a feature that allows simultaneous listening on two separate frequencies anywhere in the HF spectrum.

Two independent passband tuning (PBT) circuits, one on the 9MHz second IF and the other on the 455kHz third IF, electronically narrow the IC-7812's bandwidth using computer driven dual rotary encoders, combined with an IF shift facility, to eliminate adjacent signal interference.

A delay-controlled trigger circuit provides the IC-781 noise blanker with the ability to blank repetitive pulsed noise up to a maximum of 15 milliseconds. Together with an MCF filter at the front of the noise amplifier, this allows the IC-781 to fully eliminate OTH radar (Woodpecker) signals, even on adjacent frequencies.

Icoms' advanced direct digital synthesis (DDS) frequency locking system, a feature of all new Icom transceivers, is said to provide the IC-781 with unmatched frequency stability and the fastest lock-up time of any transceiver yet released.

For further details contact Icom toll-free on (008) 33 8915 or write to Icom Australia, 7 Duke Street, Windsor 3181.



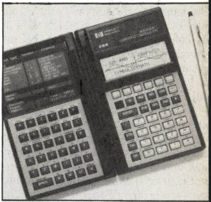
Digital storage CRO adaptor

To someone who has already invested in an analog oscilloscope, the additional capital cost of a DSO may make an upgrade prohibitive. The Polar DS102 provides a solution to this problem by offering an alternative that's cost efficient, without sacrificing performance.

In effect, the DS102 is an adaptor fully featured 10MHz sampling rate digital storage oscilloscope.

The primary features of the DS102 include true dual channel operation using twin flash analog to digital converte (one per channel), a sampling speed up to 10 megasamples/second in bo single and dual channel modes, 8 vertical resolution, 2048 byte memo per channel, conventional front par digital storage controls and a simple lead interconnection to the anal CRO.

Further details from Emona Instr ments, 86 Parramatta Road Campe down 2050 or (02) 519 3933.



New HP calculators

Four new advanced electronic calcula tors have been released by Hewlet Packard Australia. The new mode take advantage of automated productio techniques to offer very competitiv cost/benefit ratios.

The HP-19B Business Consultant ($338) is a second generation version the HP-18C. New features include bus ness graphics, a TEXT database, an 6.5K bytes of RAM compared with th previous 1.2K.

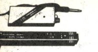
The HP-17B Business Calculato ($110) is similar to the HP-19B bu without graphics. It provides a two line 22 character LCD display.

The HP-28S advanced scientific calcu lator ($454) is HP's state of the a model for scientific problem solving. can do symbolic algebra and calculus and produce graphics either on its fou line display or on the optional HP infra red plotter. This model has 32K byte of RAM, 18 times more than the olde HP-28C.

The HP-27S scientific calculato ($212) is designed for technical profes sionals. It features algebraic entr rather than HP's usual reverse polis notation, for broader application.

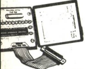
All four new models have built-in I light beam interfaces which provide cordless link to the HP 82240A printer.

Further information from Hewlett Packard Australia, 31-41 Joseph Street Blackburn 3130 or (03) 895 2895.



YSTAL LOCKED RELESS MICROPHONE D RECIEVER

ROPHONE SPECIFICATIONS:
smitting Frequency: 37.1MHz
smitting System: crystal
cillation
rophone: Electret condenser
er Supply: 9V battery
ge: 300 feet in open field
ensions: 185 x 27 x 38mm
ght: 160 grams
EIVER SPECIFICATIONS:
eiving Freq: 37.1MHz
out Level: 30mV (maximum)
eiving System: Super
terodyne crystal oscillation.
er Supply: 9V Battery or 9V DC
wer adapter.
ime control
ing LED
ensions: 115 x 32 x 44mm
ght: 220 grams
A10452 .... **R.R.P. $113**
Our price, $99



232 BREAK OUT BOX

mple way of monitoring RS232 face lead activity. Interface ered. pocket size for circuit ng. monitoring and patching gnal powered LED's and ares. 24 switches enables you eak out circuits or reconfigure patch any or all the 24 active tions.

CIFICATIONS:
nectors: DB25 plug on 80mm
on cable and DB25 socket
cators: Tricolour LED's for TD.
D. RTS. CTS. DSR. CD. TC.
C. DTR. (E)TC.
per Wires: 20 tinned end pieces.
er: Interface power.
losure: Black. high impact
astic.
ensions: 85 x 95 x 30mm
5700 .... **$94.95**

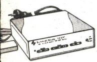
TA CASSETTES

e a small fortune with these lity 20 minute tapes. We import ct so we can pass on the savings
D11141

	10 ·	25 ·
00	**$0.90**	**$0.80**

INTERFERENCE TER

s CB/Ham signals interference.
L11048 **$5.95**



SCHMIDT 123AT MULTI STANDARD MODEM

21.V22.V23 Multi standard modem
300/300. 1200/1200. 1200 75)
uto dial "AT" command set
Hayes* compatible)
uto answer/auto disconnect
uto answerback (Similar to Telex)
uto or manual control
ial-up or leased line operation
ulse or Tone Dialing
utomatic speed ranging
peaker for call progress monitoring
aud-rate converter with 48
haracter buffer (V23)
ynchronous or asynchronous
peration
ully self contained power supply
ow power operation
letal case (R.F. shielded)
isual monitoring of important
nterface circuits (7 LED's)
ull or half duplex (V23)
ouble adaptor plug to allow use of
tandard phone (Mode 1/3/5)
elecom Authorised (C87/37/65)
.... **$595**

yes is a trademark of Hayes
rocomputer Products Inc.

COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield.
(to IE422 specifications).
Copper conductor 6 x 7/0.16mm.

1-9 metres	10+ metres
$1.90/m	**$1.70/m**

CIC9.100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm.

1-9 metres	10+ metres
$2.50/m	**$1.95/m**

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm.

1-9 metres	10+ metres
$2.70/m	**$2.50/m**

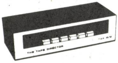
CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm.

1-9 metres	10+ metres
$3.90/m	**$3.40/m**

CIC25 25 conductor computer interface cable. Colour coded with mylar shielding. 25 x 7/0.16mm.

1-9 metres	10+ metres
$4.90/m	**$4.40/m**

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877



SPEAKER CONTROLLER (TAA801)

- Enables up to 5 pairs of stereo speakers to be switched on or off in any combination.
- Rated at 50 watts continuous per channel.
- Stereo headphone socket available for private listening.
- Constant minimum load circuit protects amplifier regardless of how many speakers are connected.
- Dual circuit breaker protection.

Cat. A16054 .... **$59.95**

BIG MOUTH CAR ALARM

FEATURES.....

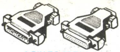
- Easy installation
- Automatic on/off
- Loud alarm signal
- Auto reset
- Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx.
Entry Delay: 12 seconds approx.
Auto reset: 90 Seconds approx.
S15048 .... **$39.95**

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

Cat. A12030 ...... **Normally $19.95**
SPECIAL, ONLY $14.95
(Note: Not Telecom approved)



9 PIN TO 25 PIN CONNECTOR ADAPTORS

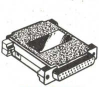
NEW! The ideal solution! Features gold plated pins.

X15668: DB9 Plug to DB25 Socket
X15669: DB9 Socket to DB25 Plug
.... **each $10.95**

CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**
Normally $33.95,
Only $24.95



RS232 GENDER CHANGERS

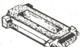
- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $14.95 each
Only $9.95

DB15 GENDER CHANGERS

- Saves modifying or replacing non mating DB15 connections
- All 15 pins wired straight through

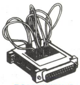
X15645: Male to male
X15646: Male to Female
X15647: Female to Female
.... **only $14.95**



DB9 GENDER CHANGERS

- Saves modifying or replacing non mating DB9 connections
- All 9 pins wired straight through

X15640: Male to male
X15641: Male to Female
X15642: Female to Female
.... **only $14.95**



RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665 ...... **Normally $49.95**
Only $44.95

PIN SWITCHES

- Self tapping and adjustable
- Suitable for car doors, hoods, trunks
- Single lead hook up
- Easy to use, easy to install
- Length: 45mm

S12522 .... **$3.95 pair**

ULTRASONIC TRANSDUCERS

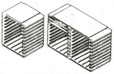
Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burgalar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.

Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 + − 1.0
Sound Pressure Level 10V RMS:
110dB min.
Sensitivity (dB/v/ubar) min.:
−65 min.
Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at −73dB)
Impedance:
Transmit: 500
Receiver: 5000
Cat. L19990 (Transmitter) . **$6.95**
Cat. L19991 (Receiver) **$6.95**

SENNHEISER HD 410 SL

The HD 410 SL embodies all the advantages of the new "Slim-line" concept: brilliant sound characteristics with an optimum of sound volume combined with high wearer comfort.

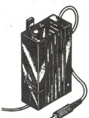
SPECIFICATIONS:
Frequency Range: 20 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Less than 1%; pressure on ear; approx. 2.5 N
Weight: Approx. 82g
Length of lead: 3 metres
Cat. A10518 .... **$74.95**



COMPACT DISC STORAGE UNITS

- Holds 10/20 compact discs in their cases
- Interlocking modular design allows vertical and horizontal interlocking
- Discs slide into place horizontally making titles easy to read.
- Wall mount or free standing.

A10031 (10 discs) **$12.95**
A10032 (20 discs) **$19.95**



STEREO WIRELESS TRANSMITTER

This unit was developed to allow portable compact disc players to be used in cars by transmitting the headphone output signal directly in to your stereo FM car radio. It will also transmit any mono/stereo signal from any headphone output to any FM receiver.

SPECIFICATIONS:

- Input 3·5mm stereo phone plug. Impedance 32 ohm.
- Mono/stereo switch has plug mounting clip.
- FM Transmission approx. 90·35MHz (Tuneable 89-91MHz)
- Range 15 metres (below 15mV/m at 100 metres)
- Power 1·5V AAA size batteries (100 hours continuous use)
- Size 72 x 38 x 21mm

A16100 .... **$69.95**

HI FI SPEAKERS

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Magnet Weight: 2 oz
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Freq. Response: 1.1 - 17 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
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Freq. Response: 650 - 15 kHz
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Magnet Weight: 3.6 oz
Cat. C10204 .... **$11.95**

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Freq. Response: 55 - 7 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 5.4 oz
Cat. C10208 .... **$17.95**

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Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10210 .... **$20.95**

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Cloth edge roll surround.
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Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13.3oz
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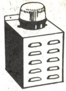

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S.P.L. (dB/W) 110
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Flashing Light:
DC 12V
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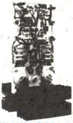

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Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Sony & TI develop digital filter LSI

Sony Corporation and Texas Instruments have succeeded in the development of a high quality digital filter LSI for digital audio equipment.

With a strong experience in the digital audio area, Sony played the key role in developing the fundamental specification of the IC and designing the filter coefficients. Texas Instruments then applied its advanced technology in digital signal processing to design the IC.

Compared to conventional digital filters, the product is said to embody improvements in several specifications such as over-sampling, bit length, and filter coefficients.

Applications for the digital filter are expected to be in digital audio tapes (DAT), laser disc players and tuners.

Major specifications of the digital filter are:

- 8 times over sampling filter
  FIR type filter three stage cascade connection (293 taps).
- Filter characteristics:
  - PAS bandwidth ripple within ±0.00001dB (0 – 20kHz)
  - Stop frequency attenuation less than −120dB (24.1k – 150kHz)
- CMOS silicon gate/double-layer metal process.
- 28 pin DIP package.

Further information may be obtained from the Semiconductor Group, Texas Instruments, 6-10 Talavera Road, North Ryde 2113.

Chips for car security systems

Unlocking a car door is a cinch – with infrared light: the invisible beam strikes the electronic lock from as far away as several metres without being affected by frost or rust problems. But conventional IR locks can easily be picked by prospective thieves who obtain an electronic "wax impression" of the optical bit pattern on the sly.

Siemens has now unveiled its new IR component set which changes the bit-pattern after every locking action. Two CMOS are used to transmit (SLE5001 in the key) and detect (SLE5002 in the lock) the particular data sequence. The bit pattern is derived from a basic code permanently stored in a bit line matrix or an EEPROM (SDE2506). In contrast to mechanical systems, the new system permits several million different combinations.

The IR component set can be fitted to central locking mechanisms, boot lids, sliding roofs or can even be used to check stored seat or mirror positions.

The CMOS chips come in three package types: DIP40, PLCC44 for SMD's, and Micropack for space-saving installation in the handle piece of the key. The electronics of the complete IR transmitter plus battery can be integrated in a car key of normal size while fully retaining the mechanical function of the key.

The system employs a new code after every locking action. On reception of a valid code, the lock is automatically set to the code the key transmitter will send next. In this way the code just received and all the previous codes used, including those obtained secretly are made ineffective. Eight non-operative codes may be transmitted without losing synchronism (capture range). In any case, depressing the transmit key for five seconds will synchronise transmitter and receiver (important for duplicate keys).

Thirty-two bits and four synchronising pulses are combined to form a complete IR transmit message which is modulated by a 125kHz carrier frequency. Each data bit consists of twelve 2.4us IR pulses and provides a peak current of 2A. The average peak current is a mere 38mA maximum. The transmitter turns off a "logic O" bit so that the battery power required per bit pattern under worst-case conditions is only 2mAs.

Siemens recommends that the user opt for a lithium battery. Its useful life is normally long enough to last for several servicing intervals of a car.

For further information contact Electronic Components Department, Siemens Ltd, 544 Church Street, Richmond Vic 3121. Phone (03) 420 7315.

Dual CMOS D/A converters

Precision Monolithics has introduced the DAC-8222 and DAC-8248, precision dual 12-bit CMOS D/A converters. Both devices are double-buffered and packaged in a 0.3 inch DIP. They offer the choice of 8-bit or 12-bit data bus architectures to accommodate 8-, 16-, o 32-bit microprocessors.

The DAC-8222 has a 12-bit inpu data bus. The DAC-8248 has an 8-bi data bus structure that accepts a 12-bi work in two bytes, an 8-bit byte fol lowed by a 4-bit nibble or vice-versa Digital inputs are double-buffered allow DAC A's and DAC B's analo outputs to be updated simultaneously.

The DACs' highly stable SiCr thi film resistor technology allows the la der resistances of the two DACs to typ cally match to within 0.2%. The precis matching results in better initial accur cy, as well as improved accuracy ove temperature extremes, since comp nents on a monolithic chip track close with temperature variations.

Both DACs offer ±1 LSB gain a curacy with ±1/2 LSB nonlinearit They also settle to within ±1/2 LSB final value for a 10V full-scale ste change in less than 1.0us. Data shee limits are guaranteed for device opera tion at +5V and +15V.

For further information contact VS Electronics (Australia), 16 Dickso Avenue, Artarmon 2064, or phone (02 439 4655.

Chip pair reads disk data at over 50Mbits/second

Capable of recovering data bits fron hard-disk-drive heads at rates in exces of 50 megabits/s, (Mbit/s), a new pair o monolithic ICs from Analog Device provides higher performance at lowe cost than existing IC and discrete circuits.

The AD890 Wideband Channel Processing Element and the AD891 Rigid Disk Data Channel Qualifier work together to take data from the disk-hea preamp, condition the noisy signal, an produce recovered data bits at rates tha allow data transfer at twice today's fastest rates.

Disk drive designers can shape th signal conditioning response via low cost, passive filters that match the rea channel to the drive platter and medi characteristics. Typical propagatio delays of 6.8ns and laser-trimmed comparators result in error rates below 1 i 10^{11} (prior to system error-correctio

cuitry). The AD890 and AD891 are
ended for high-performance drives,
t low price and flexibility in tailoring
ta recovery to the disk drive specifics
ake them suitable even for mid-range
plications with data rates as low as
Mbits/s.

To recover data from a platter surface
high speeds involves many electrical
allenges. Signal levels vary randomly
er a 40dB range, noise levels are
gh, and timing of the recovered data
lses must be precise for error free
ta/clock separation and recovery.

The AD890 processes the drive head
tput using multistage buffering, auto-
atic gain control, and a voltage-con-
olled, variable-gain amplifier to pro-
ce a clean, properly shaped signal.
is signal is decoded into jitter-free
gital pulses by zero-crossing and level
mparators in the AD891 qualifier.
e final output pulse width is set by a
er-selected resistor and temperature-
ble one-shot.

The heart of the AD890 is its
0MHz bandwidth AGC, (automatic
in control), which operates over 40dB
namic range. Gain of the AGC is au-
matically set in response to the input
vel; it can also be fixed at precise
vels by external control signals. The
riable-gain amplifier of the AGC has
equivalent input noise spectral den-
y of 5nV√Hz; the AGC control is
ear to ±0.5dB (maximum) over a
dB range, and operates effectively
er a 40dB range. Because of this IC's
curacy, fast response, and wide-rang-
g, fully temperature-compensated
GC function, it is also useful for ap-
ications such as communications re-
ivers and radar systems.

Within the AD891 qualifier are pre-
se comparators with 3.1ns typical
opagation delays, matched to better
an 300ps. The output is a low-jitter
uare pulse of precise and stable
idth, representing the detected drive
gnal with a typical 6.8ns delay which
inimises timing recovery error. Timing
ror (primarily due to offsets, gain and
ift) of this device is less than 1ns. A
ngle resistor sets the output one-shot
rcuit period from 5.4 to 180ns.

Further information from Parameters,
–27 Paul Street North, North Ryde
13.

oshiba power devices

Fastron Pty Ltd, a wholly owned sub-
diary of BWD Industries Limited, has
een appointed Australian distributor
r Toshiba Semiconductors. These
ver a wide range of components in-
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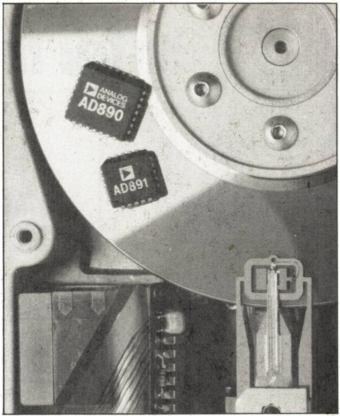
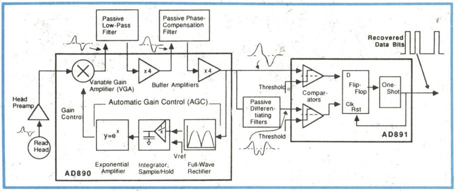


The AD890/891 chip pair from Analog Devices is designed to recover disk head data at up to 50 megabits per second. Functions performed by the chips are shown in the diagram below.



tor modules, low to medium power transistors, MOSFETS, diodes, rectifiers and thyristors.

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Further information is available from Fastron, 11-15 Kembla Street, Cheltenham 3192 or phone (03) 584 8988.

Hard disk controller

The HDC9234 Hard Disk Controller (UDC) is a 40 pin, n-channel MOS/LSI device capable of interfacng up to 4 Winchester-type hard disks to a processor. The chip is programmable to support IBM PC-AT ST506/412 and user defined hard disk formats.

A powerful and sophisticated command set reduces the software overhead required to implement a combined hard disk/floppy disk controller.

The HDC9234 can use both private memory or shared memory buffers with the chip's internal DMA controller providing up to 24 bit addresses over an 8 bit data bus. This enables the HDC9234 to address up to 16 megabytes of memory, and allows the hardware designer tremendous flexibility in system design.

For further information contact Total Electronics, 9 Harker Street, Burwood 3125 or phone (03) 288 4044.

Information centre

Low distortion oscillator

I am writing regarding your ultra-low distortion oscillator of December '86 and January '87. Herewith are details of the problems I came up against with this project, and how I solved them:

1. I simply don't believe that you ever obtained a 1us output pulse from the 555 considering your trigger pulse which, I believe, is several microseconds wide. After playing with the 82pF and 100k (pin 2 of 555, IC13) values, I soon realised that I was never going to obtain a reliable 1us supply from this circuit.

Hence I substituted a one shot (Fig.1). After all, one shots are ideally suited for this. I used half a 4538, retriggerable one shot as the other half was required somewhere else. The values selected provided me with a reliable 1.5us pulse.

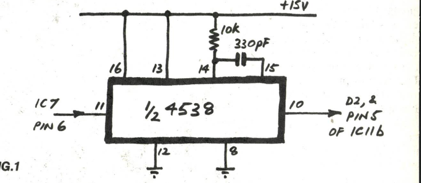


FIG.1

2. The next most important problem was that the oscillator stopped oscillating when switching ranges; not always, depending on whether switching up or down and from which range.

This seemed to be due to switching, transients and to input bias current in IC12, which both charged up C2 positively and caused pin 6 IC5 to become more negative, ensuring that the oscillator was locked off.

The requirement was obviously to discharge C2, whenever the oscillator stopped due to changing range. This I implemented with another one shot as shown in Fig 2.

3. There was also a situation whereby the oscillator amplitude could not be controlled – i.e., pin 6 of IC5 output voltage was −13V say, but the oscillator output at pin 6 of IC4 was a maximum and limiting. I also found that for the S1 range capacitor valves given i.e. 390pF, 3.9nF, 39nF and 0.39uF – the maximum frequencies were around 200kHz, 20kHz etc, rather than your specified 100kHz and so on.

Hence, I re-selected these values to provide a maximum of just over that frequency to be obtained and a minimum just below the range to be covered. I also had to reselect the 3.9k between IC2 and IC3; in my case the right value turned out to be 6.8k.

Further, to obtain fast pull-in and complete stability on all ranges I had to carry out some changes, as follows:

(a) Change resistor to ground at I pin 3 from 470Ω to 1.2k.

(b) Remove all frequency roll off c pacitors from IC1 (18pF), IC2 (22pF IC3 (22pF).

(c) Fit a 330Ω resistor between pin of IC11d and ground to limit dischar current. There is no need to complete discharge C1 between cycles, anyway.

(d) Increase C2 from 560pF to 1nF but this change was not critical.

(e) Change the values around IC5 per Fig.3. The bypass capacitor on pin seemed critical, and should be taken the nearest earth.

(f) Change the 1nF capacitor at pin of IC 11a to 330pF, as IC11d would n switch properly anymore at high fr quencies – i.e., approaching 100kHz.

4. I could not appreciate the impo tance of the bipolar 47uF capacit

FIG.2

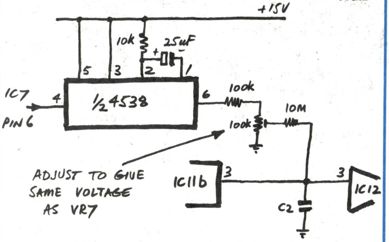


FIG.3

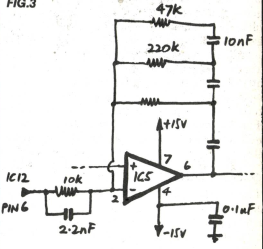
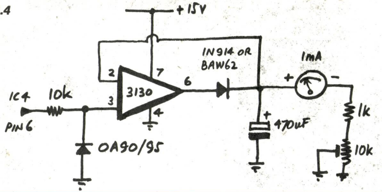


FIG.4



upling pin 6 of IC4 to the output at-
uator, as the DC offset at this point
uld only be very small (i.e. 1 or 2
V) and the capacitor was difficult to
tain. I elected to omit it altogether.

Your metering circuit was also fre-
ency conscious. I substituted for it
th the circuit shown in Fig.4.

he oscillator worked well after I im-
mented the above changes. A friend
mine, who had similar difficulties,
plemented my modifications as well
d his generator works now too.

n conclusion, I don't understand how you could allow this article to be printed. (H.P., Strathfield, NSW).

• ***Quite a few people do seem to have had trouble with this project, which was developed by previous staff. As a result, we are working on a similar but rather simpler and more straightforward project to replace it, as soon as possible.***

In the meantime, thank you for your courtesy in writing, and giving details of your remedies for the problems you and your colleague encountered.

ual tracking supply

I recently purchased the February
87 Dual Tracking Power Supply in kit
rm, as the time had arrived when such
supply was required on the work-
nch. The kit was of high quality with
couple of minor exceptions, and was
nstructed in a minimum of time with
minimum of effort.

Upon completion, the time came for
ower Up', and the various voltages
., were read in accordance with the
structions.

The +/−28.5V rails were in fact
−32/33V, which in fact should be ex-
cted using the 22-0-22V transformer
ovided, and the output voltages from
e supply were as specified, i.e.,
−21.5V as well as +5V.

The next step was to load the +5V
tput with a 4.7 ohm resistor, to draw
proxiamtely 1 amp, and check that
e dropout LED illuminated when the
tput voltage exceeded 17V. But when
e 4.7 ohm resistor was connected, the
hole supply simply 'died' with low out-
ts. With the resistor removed all re-
rned to normal.

After much searching and testing, the
ttom line was (after trying four
05's) that the input voltage to the
05 was on the upper limit according
specifications, and that the small cur-
nt being drawn to supply the internals was acceptable, but when asked to supply 1 amp as well as cope with the high input voltage the 7805's would just shut down.

The transformer supplied with the kit was not an Arlec as contained in the original article but of another unidentified brand. However it had the same ratings. An Arlec transformer was in fact substituted, but the results were the same.

The transformer was then replaced with a 20-0-20V Ferguson PL40/60VA. The supply rails were then +/−27V and all problems disappeared, the supply now performing in accordance with the specifications laid down in the original article.

There seems to be a lesson here, that when the voltage outputs of transformer/rectifier combinations are quoted by the manufacturer, they (the voltages), are those available when the transformer is fully loaded, and due consideration should be paid to these figures, when the design is undertaken.

I have not read any notes and errata for this project and perhaps few, if indeed any, constructors have had this problem. Perhaps they have decided to accept the correct + and − tracking outputs, and not worried about the +5V capability.

I would appreciate any comments you may have regarding the above and in

stamp for list — Hundreds of other items not listed — Send 40c

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1.5 Meg Single	$ .50	25K	$ .50
100K Dual Concentric	$1.50	¼ Meg Dual Concentric Linear	$1.50
½ Meg Ganged Log	$1.50	100K Log Switch	$1.00
2 Meg Linear Ganged	$1.00	50K Mini 4 for	$1.00
10K Dual Concentric Double Pole Switch	$1.50	10K Mini 4 for	$1.00
25K 4 Gang Linear	$2.00	50 Ohm	$ .50
20K Linear Single	$ .50	0.25 Meg Dual Concentric	$1.00
1 Meg Log Switch	$1.00	25K Dual Ganged Switch	$1.50
1 Meg Dual Ganged Log	$1.00	10K Dual Ganged Switch	$1.00
100K Sub Mini	$ .50	250K Dual Ganged Switch	$1.00
10K Sub Mini	$ .50	1 Meg, ½ Meg Dual Concentric TAP 40K Double Pole Switch	$1.50
50K Log Switch	$1.00	300 Ohm Linear	$ .50
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50K Log	$ .50		

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250k single
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10k single
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1 meg dual
2 meg dual
2 meg single

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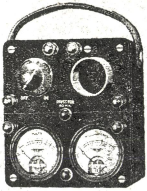
stamp for list — Hundreds of other items not listed — Send 40c

What was it?



Our mystery object this month was a very early example (1928) of something that became very popular in radio dealers for a few decades, and then disappeared. Can you guess what it did? *(Answer next month)*

June's mystery item:

The mystery item in the June issue was a Radiokes 'reaction coil' – an RF (radio frequency) coil with a small secondary winding mounted on a control shaft, so that it could be rotated with respect to the axis of the main coil. The main winding was in the grid circuit of the detector valve, with the rotatable winding in the plate circuit. Rotating the shaft with the knob allowed the degree of positive feedback to be set just short of oscillation, for maximum gain and selectivity.

Serviceman

continued from p.50

The cure for this mysterious probl
was as simple as it was dramatic.
quarter turn of one of the three scre
and the sound was back in full force.
nearly deafened me because the volu
control had been left turned full on!)

And the funny thing was, the fa
could not be recreated. I loosened
screws by two turns and they still ma
good contact. I took them right out
the board, and just the pressure of
board itself was enough to make go
contact. Yet there had been an app
ciable resistance between the t
points. I can't explain why.

I can only bemoan the rotten lu
that landed this one in my lap after
the "hard" work had been done and
accounts completed. Better luck n
time, I suppose!

continued from previous page

the meantime I have a low mileage M5502 for sale. (D.G.H-T., Kilsyth, Vic)

- ***Your observations and measurments prompted us to have a careful look at the prototype of this project, and there does appear to have been an oversight when specifying the transformer. The prototype actually uses an Arlec model 5755 (20-0-20V), rather than the listed 5502 (22-0-22V).***

As your measurements show, the small increase in the unregulated supply places the 7805 chip at its voltage limit.

There are two possible solutions to this problem. One is to replace the transformer with a 20-0-20 volt model (as you have done). The other is to reduce the input voltage to the 7805. A couple of power diodes in series with the input leg should return the chip to its safe operating area.

Once again, thank you for your detailed information on this problem.

Notes & Errata

IMPROVED 300W 12/230W INVERTER (April 1988): Four of the 1N5404 power diodes in the autostart circuitry are wrongly labelled D5-D8 on the overlay diagram printed on page 81; these should be labelled D13-D15 respectively. The four concerned are those at the lower left-hand corner of the diagram, just above C15. The circuit diagram is correct. (File No. 3/IT/17)

POWER TRANSISTOR TESTER (May 1988): The parts list wrongly shows two 100 ohm 1W resistors. One of these should read 180 ohms 1W. The circuit diagram is correct. (File No. 7/VT/19)

Frankly Frank

continued from p.

so the generation of business obviou
isn't confined to the actual project a
buildings, etc.

To finally sum up the huge Americ
instrument we can look at a compa
son. A proton on the track is equivale
to a virus in Saturn's orbit around t
sun (I hope that orbiting virus is t
one that gave me a cold last weel
Fortunately for the Americans there a
rather a lot of protons in each strea
or they might miss.

In every case where man has som
thing to do with science or technolog
something goes wrong. I wonder wh
will happen when one of those 20 tr
lion electron volt streams hits the si
of the tunnel? I think I'd rather re
about it than watch it happen, exce
on TV via satellite.

Letters

continued from page 7

will be in the ratio of 9:1 and semi-log 5:1.

I hope this will help your two correspondents as well as any others who have suffered at the hands of Murphy in this way.

Phil Allison,
Summer Hill, NSW.

Not fax, Viatel!

At the end of the "Serviceman" in the May edition of EA, the suggestion was made that a Fax network among servicemen would facilitate exchange of information about servicing problems.

I have no objection to this means of communication and I'd like to be able to join such a scheme but, unfortunately, I can think of better things to do with $3000 to $5000 than to spend it on a Fax machine.

Then with Australia Post charging $6 per page for the use of their Fax machine, there is no way I can afford to use their services, either.

An alternative means of distributing information is via Telecom's "Viatel" service. A colleague and I already use this service to trade information (and the occasional insult) and we find it quite convenient, economical and a lot of fun.

Our contact is on a one-to-one basis, but space on Viatel can be rented by "Closed User Groups". These CUG's allow the general distribution of inf
mation, and the exchange of perso
messages among members of the grou

A group such as this, formed amo
service organisations and individua
would allow quick and economical co
munications at far lower cost than t
purchase and operation of Fax m
chines. Anyone wishing to contact
can do so on Viatel 024 388 490.

Finally, TETIA and TESA (see E
June '87) distribute service informati
among their members and have done
for many years. Membership of th
organisations would be a valuable as
to any practising serviceman.

Jim Lawler (MTETIA),
Hobart.

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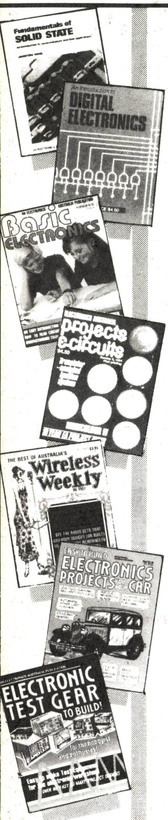
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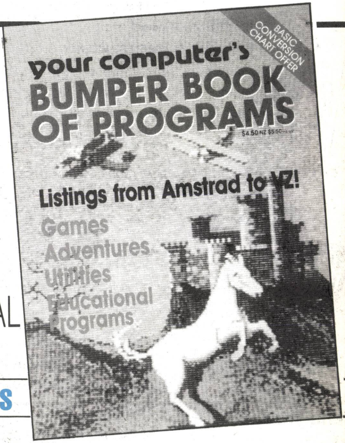

50 and 25 years ago..

lectronics Australia" is one of the longest running technical publications in the rld. We started as "Wireless Weekly" in August 1922 and became "Radio and bbies in Australia" in April 1939. The title was changed to "Radio, Television d Hobbies" in February 1955 and finally, to "Electronics Australia" in April 65. Below we feature some items from past issues.

Wireless Weekly 3D

July 1938

eville's "Iron Horse": More and re attention is being paid to the uses small petrol-driven generators for me lighting. Breville Radio are hav- a very successful time with their on Horse" plant made by Johnson. O'Brien, of Breville, is just conclud- a very successful trip through S.W. and Queensland, and has al- dy sold quite a number of units. re are some details of the Iron Horse plied by Breville.

ts capacity of 300 watts will light lve 25-watt lamps – which means that it has 50 to 100 per cent larger capacity than other plants.

H.M.V. De-luxe Model: It is the usual thing, when taking delivery of an H.M.V. receiver for test, to remark immediately on the excellent standard of the cabinet work. The Model 305, which is a large 7-valve vibrator set, is certainly no exception. The cabinet is particularly fine in appearance, and just as fine in actual finish. One could not ask for a better piece of work in a cabinet of its type, and it looks the quality set which undoubtedly it is.

Radiokes Vibrator unit: The Radiokes Vibrator unit can be used with any battery receiver which employs either 2-volt, 4-volt, or 6-volt valves. The method of connection is quite simple, as the connections are made in a similar manner to the existing B battery.

RADIO, TELEVISION and HOBBIES

July 1963

Stills from television: A new magnetic picture storage system has been invented to permit a single picture to be selected during a TV transmission and reproduced when required as a still.

Devised by Siemens and Halske, of 18 Oskar-von-Miller-Ring, Munich, West Germany, it is suitable for application in scientific and technical closed-circuit TV systems.

When the controller decides a still is required, a push-button is depressed and the incoming signals from the TV camera are magnetically recorded on a storage foil.

The recorded signals are then used to reproduce a still on an adjacent monitor screen.

The storage disc itself, 40 centimetres across, can take ten full-sized or 20 half-sized pictures. Erasing, recording and reproduction is an electronically controlled sequence.

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JULY CROSSWORD

ACROSS

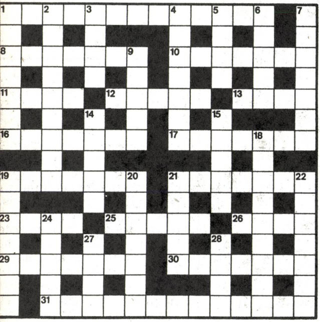
. Power cutter. (8,5)

. Professional person of ubstance? (7)

10. Element used in plating. (7)

11. Customs charge on portable TV sets, etc. (4)

12. Cells in plasma! (5)



13. Fuse. (4)

16. Electric traction system. (7)

17. Studio screen. (7)

19. Control stations for alarm systems. (7)

21. What Edison first saw in 31 across. (7)

23. Certain microphones are worn here. (4)

25. Turn in conduit. (5)

26. Thin foil. (4)

29. A warble, as in some sirens. (3-4)

30. What telephoned callers are said to be on. (3,4)

31. Modern illumination. (8,5)

DOWN

1. Device that converts data into digital format. (7)

2. Switch on (with excitement). (9)

3. Term used for a survey station. (4)

4. Small resistance unit. (7)

5. Said of band with large range. (4)

6. Result of increasing output? You bet! (5)

7. Electronic clipper or slicer. (7)

9. The box. (5)

14. Improve tune, often by ear. (5)

15. Traditional studio warning sign. (2,3)

18. Unauthorised interference. (9)

19. Type of energy in motion. (7)

20. It's part of the solution of this crossword! (7)

21. Secondary image. (5)

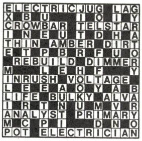
22. What TV signals do to form 21 down. (7)

24. Term applied to similar PCs, etc. (5)

27. Semiconductor's empty energy level. (4)

28. First name of first man on the moon. (4)

JUNE SOLUTION



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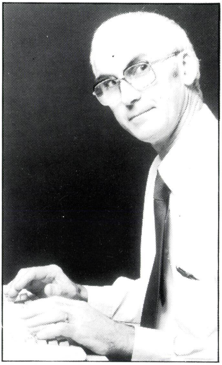

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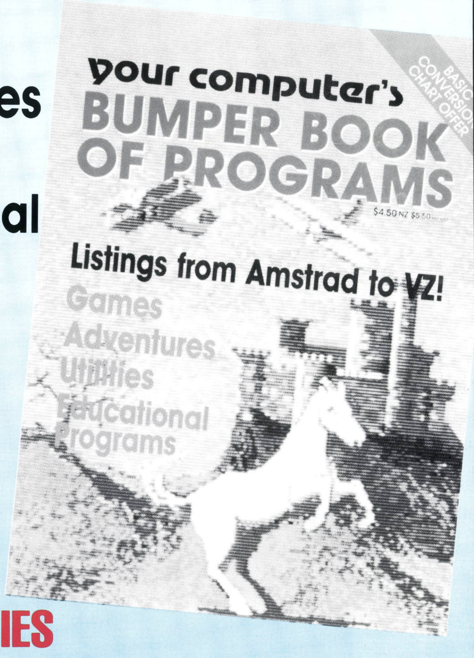

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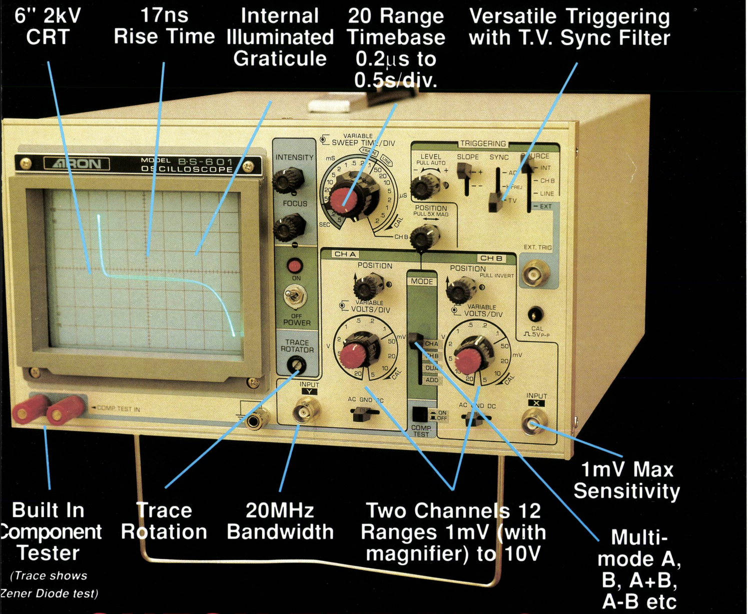
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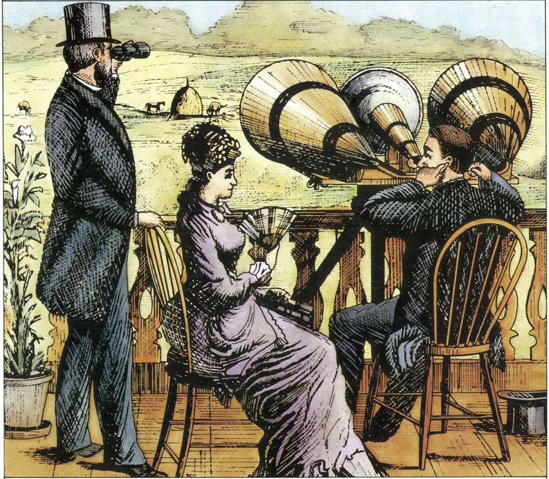

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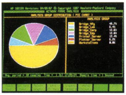

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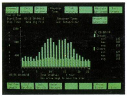

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